W72-11272

CLEAN WATER

WATER POLLUTION CONTROL RESEARCH SERIES ● 16110 FRU 12/71-7

PB 210 859

The River Basin Model:

SCHOOL DEPARTMENT

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

U.S. ENVIRONMENTAL PROTECTION AGENCY

96

WATER POLLUTION CONTROL RESEARCH SERIES

The Water Pollution Control Research Series describes the results and progress in the control and abatement of pollution in our Nation's waters. They provide a central source of information on the research, development, and demonstration activities in the water research program of the Environmental Protection Agency, through inhouse research and grants and contracts with Federal, State, and local agencies, research institutions, and industrial organizations.

Inquiries pertaining to Water Pollution Control Research Reports should be directed to the Chief, Publications Branch (Water), Research Information Division, R&M, Environmental Protection Agency, Washington, D.C. 20460.

The RIVER BASIN MODEL:

School Department

by

Envirometrics, Inc.
1100 17th Street, N.W.
Washington, D.C. 20036

for the
Office of Research and Monitoring
Environmental Protection Agency

Project #16110 FRU
Contract #14-12-959

December, 1971

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 - Price $1.00

EPA Review Notice

This report has been reviewed by the Environmental Protection Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names of commercial products constitute endorsement or recommendation for use.

SELECTED WATER RESOURCES ABSTRACTS
INPUT TRANSACTION FORM

W 72 11272 ~~72 10344~~

THE RIVER BASIN MODEL: SCHOOL DEPARTMENT,

EPA Program 16110 FRU 12/71-7

Envirometrics, Inc., Washington, D.C.

(Water Pollution Control Research Series)
~~Prepared for Office of Research and Monitoring, U.S.~~ Environmental Protection Agency, ~~Project #16110 FRU, Contract # 14-12-959~~, December, 1971. 94 p, 25 fig, 3 tab, 2 append.

The RIVER BASIN MODEL and its users represent an entire regional system's economic, social, and governmental activities; water decisions are placed within their realistic context of having different importance to different individuals as a function of their occupation, location, resources, and personal inclinations. The model is a human interaction, computer-simulation decision-making tool. Its users provide inputs to the computer programs on behalf of business activities in an Economic Sector, groups of people or population units in the Social Sector, and government departments in the Governmental Sector. A gaming format is employed. Presented is a description of the functions of the Government Sector and the model required by its School Department. The Government Sector represents the management apparatus for the public sector of the area represented by the Model. Its participants are the elected and appointed public officials. This Sector can make public policy, implement plans and programs, provide public services and raise and disperse funds. The School Department provides child and adult education for citizens in the local jurisdictions. The demand for school services within a district is dependent upon the number and class of population units located within the boundaries of the school district. (Bell-Cornell)

*Regional analysis, *Education, *Simulation analysis, *Computer programs, *Decision making, *Mathematical models, *Water demand, *Water users, *Water pollution control, *Treatment.

*Public policy, *Governmental processes, *Gaming-simulation.

Copy available from GPO Sup Doc EP 2.10:16110 FRU 12/71-7 $1.00 ; microfiche from NTIS as PB 210 557, $0.95.

06A, 06B, 06D

19. Security Class. (Report)
20. Security Class. (Page)
21. No. of Pages
22. Price

Send To:
WATER RESOURCES SCIENTIFIC INFORMATION CENTER
U.S. DEPARTMENT OF THE INTERIOR
WASHINGTON, D.C. 20240

Janet Bell | Cornell

SCHOOL DEPARTMENT MANUAL

	Page
I. Introduction to the Model	1
A. Brief Description of the Model	1
B. The Three Sectors	2
1. The Economic Sector	4
2. The Social Sector	5
3. The Public Sector	6
C. The Water Component	8
D. The Local System	8
E. The Unit of Time--A Round	10
F. The Function of the Computer	11
II. The Government Sector	13
A. Introduction to the Sector	13
B. Sector Functions	13
C. Administrative (Non-Decision) Functions	15
D. Government Decisions	15
E. Government Output	15
F. Government Budgetary Procedures	18
G. Government Master Table	21
II. School Department	22
A. Introduction	22
B. School Department Summary	23
IV. Computer Printed Output Description	25
A. Introduction	25
B. Map Output	27
1. Economic Status Map	30
2. Government Status Map	33
3. Socio-Economic Distribution Map	35
4. Demographic Map	37
5. Topographical Restriction Map	39
6. Social Decision Maker Map	41
C. Summary Information	43
1. Demographic and Economic Statistics	43

Page

D. Computer Output Explanation for the School Department.... 48

1. School Department Report 48
2. New Construction..... 52
3. School Department Finances 52
4. School Map 54

V. School Department Decisions 56

A. Summary of Decisions 56
B. Input Format 57
C. Sample Decisions 62

VI. Master Sheets for the School Department 67

Appendix A - Sequence of Computer Print Out 70

Appendix B - Commercial Output 88

I. INTRODUCTION TO THE MODEL

A. Brief Description of the Model

In a sense, the RIVER BASIN MODEL is a misnomer because if one places an emphasis on "River" it leads one to believe that the model is primarily concerned with water management. The emphasis should be placed on "River Basin", and that term should be interpreted in its broadest context as meaning a geographical area of land. Through its two major components -- human interaction and computer simulation -- the model represents the economic, social and governmental activity that takes place within the geographical boundaries defined by the river basin or more simply by a group of continguous counties.

The model is unlike most other simulation or human interaction models. It was not designed to accomplish any one specific purpose. Rather it was designed to let its users represent the major economic, social, and governmental decision-makers who cause a regional system to function and change on a year-to-year basis. As part of the functioning of this regional system, water is demanded by industries and municipal water suppliers and pollution is generated by manufacturing and commercial activities, by people, and by farm activities.

The model is a computer-assisted decision-making tool, in which a number of computer programs simulate major processes that take place in the local system such as migration, housing selection, employment, transportation, shopping patterns, the allocation of leisure time, and water quality determination. Users of the model provide inputs to these programs on behalf of business activities in the economic sector, groups of people or population units in the social sector, and government departments in the government sector.

Normally, the users of the model are assigned decision-making responsibility for businesses, population units, and government departments in a gaming format. This means that users become members of teams that are assigned control of:

1. Economic Assets: cash, land, manufacturing plants, outside investments, commercial activities, and/or residences.

2. Social Assets: population units that are designated as high income, middle income, and/or low income.

3. Government Assets: power of the budget, taxing and assessing authority, service responsibility, and planning and regulatory power.

The computer print-outs for a year provide a detailed description of the regional area represented by the model, and the users of the model evaluate this status as individuals, as team members, and collectively to define problems, establish objectives, develop strategies, implement plans, and react to feedback from the new computer printout for the next year.

The initial starting position shows a particular set of allocations of the locals system's resources and their effects on the status of the local area. The users of the model evaluate their own particular status within the local system as well as the status of the area as a whole. They then interact with one another in a dynamic decision-making environment in which they collectively have control over the local water quality decisions that will be made, implemented, and reacted to. Some of the model players may have apparently only marginal interests in the local water quality issues because they are pre-occupied with running schools, building roads, earning incomes, producing manufactured goods, building housing, and supplying local goods and services. Others will have maybe more interest as they attempt to be elected into public office, run the planning department, collect taxes, recreate, and develop a generally pleasant environment for their new residential subdivisions. Still others might have a direct and pressing interest in the local water quantity and quality as they attempt to set and enforce water quality standards, supply municipal water, use surface water in their production process, and benefit from major water-based recreation areas.

In short, the entire local system is represented by the model and its users, and water decisions are placed within their realistic context of having different importance to different individuals as a function of their occupation, location, resources, and personal inclinations.

B. The Three Sectors

The model contains three basic decision-making sectors: economic, social and public. (Figure 1) Every city or region contains these three vital sectors whose interactions cause the area to function and to either grow and prosper or stagnate and decay. Decisions made by one group ultimately affect others

Figure 1

THREE DECISION-MAKING SECTORS AND CONSTITUENT TEAMS

ECONOMIC TEAMS
(Identified by single letter codes: A, B, C, etc.)

INDUSTRIAL DECISION-MAKER

- HI-Heavy Industry
  - FL-Furniture and Lumber
  - SG-Stone Clay and Glass
  - MP-Primary Metals
  - MF-Fabricated Metals
  - NL-Nonelectric Machinery
  - EL-Electric Machinery
  - TE-Transportation Equipment
- LI-Light Industry
  - FO-Food
  - TA-Textiles and Apparel
  - PA-Paper
  - CR-Chemicals, Plastics and Rubber
- NS-National Service

COMMERCIAL DECISION-MAKER

- BG-Business Goods
- BS-Business Services
- PG-Personal Goods
- PS-Personal Services

RESIDENTIAL DECISION-MAKER

- RA-Single Family
- RB-Garden Apts. and Duplex
- RC-Multiple Unit and High Rise

GOVERNMENT TEAMS
(Identified by the specific code preceding the department name)

- CH-Chairman of Jurisdiction
- CO-Councilman
- AS-Assessment and Finance
- SC-School
- MS-Municipal Services
- UT-Gas, Electric, Water and Sewer
- HY-Highways
- BUS-Bus Company
- RAIL-Mass Transit Agency
- PZ-Planning and Zoning

SOCIAL TEAMS
(Identified by double letter codes: AA, BB, CC, etc.)

- PH-High Income
- PM-Middle Income
- PL-Low Income

and one group often works against another group to achieve its goals. For example, proposed commercial developments by an economic group in a predominantly residential area can be blocked by residents of that area just as proposed changes by the government departments can be opposed by those participants in the economic or social sector.

1. The Economic Sector

Economic decision-makers are those businessmen who operate industrial, commercial, residential and farm establishments. Upon receiving output at the beginning of the round economic decision-makers review their economic status and make decisions for the present round. The various economic activities in the model have the following characteristics:

Basic Industry

Heavy Industry, Light Industry and National Services spend money for business goods and business services, utilities, a labor force, transportation, and taxes. In order to produce basic industry output which is then sold to the national markets at prices determined by national business conditions (the computer), owners of basic industries can make a wide variety of decisions. These decisions include purchasing land, changing salaries or maintenance levels, boycotting business goods and business services establishments, acquiring laons, building new businesses, upgrading existing businesses, demolishing old ones, and treating effluents that are dumped into the local water system.

The basic industry of the economy can be further subdivided into the following categories:

HI - Heavy Industry

- FL - Furniture and lumber
- SG - Stone, clay and glass
- MP - Primary metals
- MF - Fabricated metals
- NL - Non-electrical machinery
- EL - Electrical machinery
- TE - Transportation equipment

LI - Light Industry

FO - Food
TL - Textile, apparel and leather
PA - Paper
CR - Chemicals, plastics, and rubber

NS - National Services

Commercial Establishments

Business goods (BG) and business services (BS), personal goods (PG) and personal services (PS) spend money on many of the same items as basic industry in order to maintain a level of service capacity. This service capacity is consumed or partially consumed by local customers which include: the industrial sector, other commercial establishments and the population units (Pl's) who live in the city. Owners of the commercial establishments may make most of the decisions that owners of basic industries make in addition to setting prices for their products.

Residences

Single-family (RA), townhouse (RB), and high-rise (RC) residence units spend money on personal goods and personal services, utilities, and taxes, and earn income based on rent charged and the number and type of occupants residing in their housing units. Owners of residences may make the same types of decisions made by owners of basic industry in addition to setting the rent paid by their tenants.

Farms

Farm owners make very few decisions aside from how their land will be utilized and what level of fertilizer use they will employ.

2. The Social Sector

Decision-makers in the social sector represent the citizens who live and work in the simulated area. People are represented in terms of population units (Pl's). Each population unit represents fixed numbers of people (500). Population units are divided into three socio-economic groups: high income (PH), middle-income (PM) and low-income (PL). Because each class possesses its own expectations and behavioral patterns, each will have different preferences for residence, job, and schooling, etc. Social decision-makers can vote on behalf of the Pl's which they represent. Voting power is dependent upon the number of

population units controlled, the number of registered voters in each, and their socio-economic class. Social decision-makers can also direct the population units under their control to boycott places of employment or shop locations. Social decision-makers can also allocate leisure time of their population units to be spent in any of four basic activities: extra work, adult education (public or private), politics, and recreation. The amount of time spent on each of these activities has an effect on the socio-economic status and/or the dissatisfaction index of people living within the city.

A significant part of the model centers around how Pl's function within the local system during the course of each round of play which represents one year of time in the local area. Figure 2 shows the actions of Pl's as they are affected by the major operating programs.

3. The Public Sector

In the model, the government sector deals with the problems of education, highways, municipal services, planning, zoning, utilities, water supply and quality and bus and rail transportation. The public sector is divided into two basic components. The first component includes elected officials: the Chairman and the Council. These officials are elected by the social decision-makers representing the people who live in each jurisdiction. The Chairman and Council set tax rates, approve budgets, grant subsidies and appropriations, and make appointments. Appointed officials named by the Chairman are heads of these six governmental departments: Assessment (AS), Schools (SC), Municipal Services (MS), Highway (HY), Planning and Zoning (PZ), and Utilities (UT). The Bus and Rapid Rail Companies are semi-private organizations which also may be appointed by the Chairman. Players representing these departments make decisions which include allocating capital and current funds, changing salaries and maintenance levels, requesting federal-state aid, changing district boundaries, constructing or demolishing public buildings, upgrading public buildings, changing levels of service, and transferring cash between accounts.

Figure 2

Example of How Population Units Are Affected by the Major Operating Programs of the Model

Major Operating Programs	Effect on Population Unit
Migration	Pl's move to the local system, find and change housing within the local system, leave the local system
Water System	Poor water quality incareses dissatisfaction and high coliform count increases health costs and time lost due to illness.
Depreciation	Housing that depreciates becomes less attractive in the migration process.
Employment	Pl's are assigned to full and part time jobs that maximize net income (salary minus transportation costs), employers search for best educated workers.
Transportation	Pl's travel to work by the mode and route that minimizes total costs (dollar plus time), Pl's travel to shopping along the minimum cost routes.
School Allocation	Students of Pl's are assigned to public or private schools based upon the quality of public schools.
Park Allocation	Pl's are assigned to parks within a specified distance of where they live.
Time Allocation	Involuntary expenditures of leisure time are calculated as a function of the success of getting part time jobs, public adult education and the time spent on transportation.
Commercial Allocation	Pl's are assigned to stores at which the total costs are minimized (price plus transportation to the store).

C. The Water Component

The water component is a subsector that, in a sense, cuts across the other three sectors or is a part of each. For example, some of the industrial activities in the economic sector use surface water in their production process and all other economic businesses have some need for municipally supplied water. Population units in the social sector use water as a function of their income class and the type of housing they inhabit. In the government sector, the Utility Department is responsible for supplying the municipal water needs of the residents of its jurisdiction.

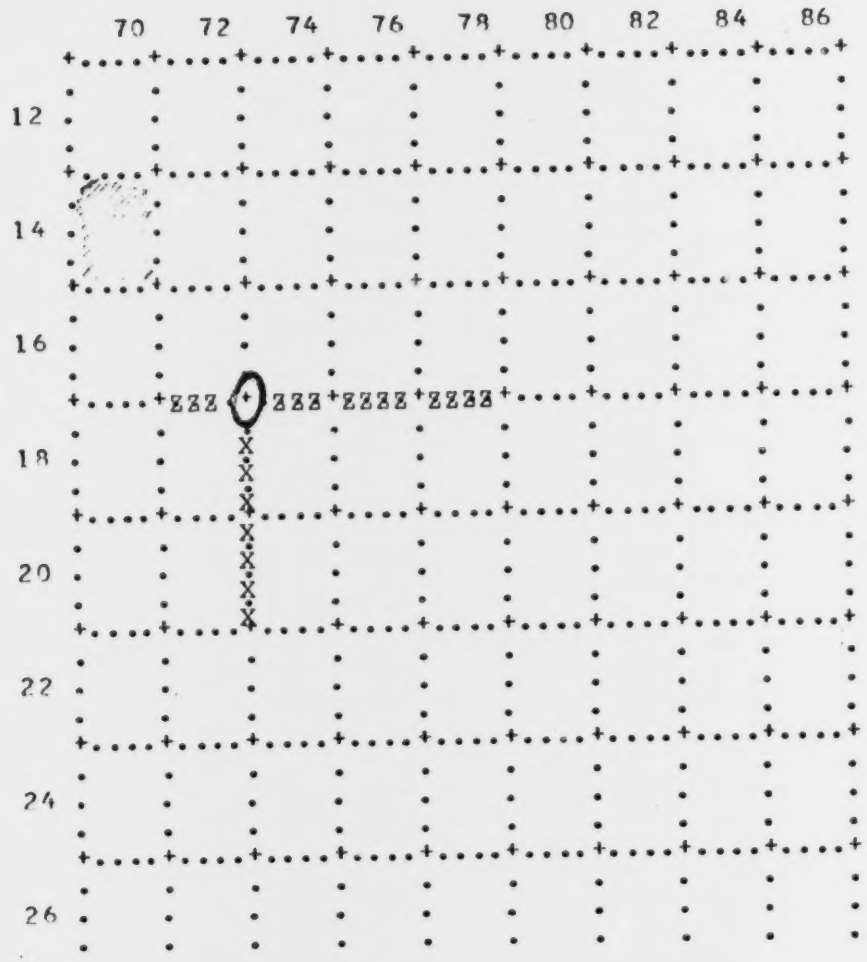
Each of the surface water users requires a specified quality of water and must either treat the water they intake or purchase water from a source outside of the local system. Every water user adds some pollutants to the water it returns to the water system. If left untreated, these water discharges may lower the quality of water of the body of water into which they are dumped. Since water users and polluters are located in a geographical space, acitivities upstream and downstream are affected differently by the dynamically created water quality conditions.

D. The Local System

The particular regional configuration being used is represented on a grid map consisting of 625 squares. Each square is of equal size and represents 6.25 square miles, 2.5 miles on a side. The grid and all of the computer maps are keyed to a coordinate system. Each parcel can be identified by its coordinates. Horizontal coordinates range from 70 to 118 and vertical coordinates from 12 to 60. Intersections are identified by the odd-numbered coordinates and highways are identified by even-odd (east-west) or odd-even (north-south) coordinates. In all cases, the horizontal coordinate (i.e., the larger number) is identified first.

For example, on the map in Figure 3 the shaded parcel is identified as 7014. Further, the four mile highway indicated by ZZZ is identified as 7217, 7417, 7617, 7817, while the two mile highway indicated by XXX is identified as 7318, 7320. The intersection marked by 0 is located at 7317.

Figure 3



E. The Unit of Time -- A Round

In the model, a round represents a year of change in the life of the simulated area. From the standpoint of the participants, however, a round may be thought of as a decision-making cycle which starts when they receive their computer output and ends when they hand in their decision input forms for processing by the computer.

During the early part of the typical round, decision-makers will be simultaneously reviewing their computer output and attempting to organize their possible actions. Economic decision-makers, for example, will probably attempt to acquire parcels of land that look good for future development purposes. They may attempt to secure loans from local or outside sources, apply for zoning changes, request utility expansions, and lobby for increased highway access. At the same time, social decision-makers might be bargaining for higher wages, requesting improvements in local schools and municipal services, lobby for higher water quality in the local river, and trying to promote those politicians who see things their way.

Meanwhile, the governmental decision-makers may be receiving requests from the economic and social decision-makers to lower taxes, improve schools, provide better municipal services, expand highways, build additional utilities, enlarge the park system, and improve other services. Budget officials are faced with the task of finding additional revenue to meet expanding public needs and dividing appropriations among the many local departments, all of which have attempted to justify their expanding budgets. Also the government office concerned with water quality might be pressuring the polluting industries to treat their wastes or face regulatory action. All water users might be concerned with water quality and quantity in so far as it affects their cost of using water and doing business.

Toward the middle of the round, it becomes clear to many decision-makers that all of their requests will not be granted. Thus, trade-offs and bargains must be made. Elected officials will begin to worry about staying in office. Departments must often plan to operate with less funds than they had requested. Low income representatives attempt to make their political power felt. High-income representatives attempt to maintain their status. Businessmen begin to look for short-cuts to reduce their losses and increase their activity and profit-making ventures. The water quality office begins to act upon its earlier threat.

As the round approaches a conclusion, the participants formalize the bargains they have made, continue to fill out their decision forms, terminate the negotiations on new wage levels, new prices and new rents, carry on their boycotts and complete any other possible actions. All water related decisions by the private and public decision-makers are completed. Treatment plants are built, industries shut down, fine levied, sampling stations constructed, etc.

When the round ends, participants campaign and carry out new elections, hold town meetings, debrief their actions, and develop new strategies while the computer performs its functions and prepares new output on the status of the simulated city.

F. The Function of the Computer

In the model, players are able to exercise a number of decision alternatives. Only some of these will be communicated to the computer, the rest will be part of the constant communication, bargaining and negotiating carried out in the game-room itself.

The computer performs several major functions in the model.

First, it stores all the relevant economic, social and governmental statistics for the area; updates data when changes are made; and prints out yearly reports on the status of the local system and reports for the economic, social, and government decision-makers.

Second, the computer simulates the actions of the outside system. For example, the computer simulates both a national business cycle, the probabilities of federal-state aid and interest rates on most loans.

Third, the computer performs certain routine functions or processes that would be time-consuming if the players themselves were to perform them. For example, the computer assigns workers from population units to jobs under the assumption that workers will attempt to earn as much money as possible. Other processes include assessing all property, assigning buyers of goods and services to shop at particular commercial establishments, assigning children to public or private schools based upon the capacity and quality of the public schools, and assigning population units to residences based on their desirability. The computer also simulates the migration process which moves population units into, out of, and within the local system. It also measures all of the types of pollution at all points along the river system and calculates a comprehensive water quality index.

II. THE GOVERNMENT SECTOR

A. Introduction to the Sector

The GOVERNMENT SECTOR represents the management apparatus for the public sector of the area represented by the model. Participants in this Sector are the elected and appointed public officials. The Government Sector can make public policy, implement plans and programs, provide public services and raise and disperse funds. The model is sufficiently flexible that the Government Sector can be operated using strong central control or somewhat autonomous departments as determined by the participants. There is a separate government apparatus for each of the political jurisdictions represented by the model. Thus, intergovernmental cooperation and competition may evolve during the play.

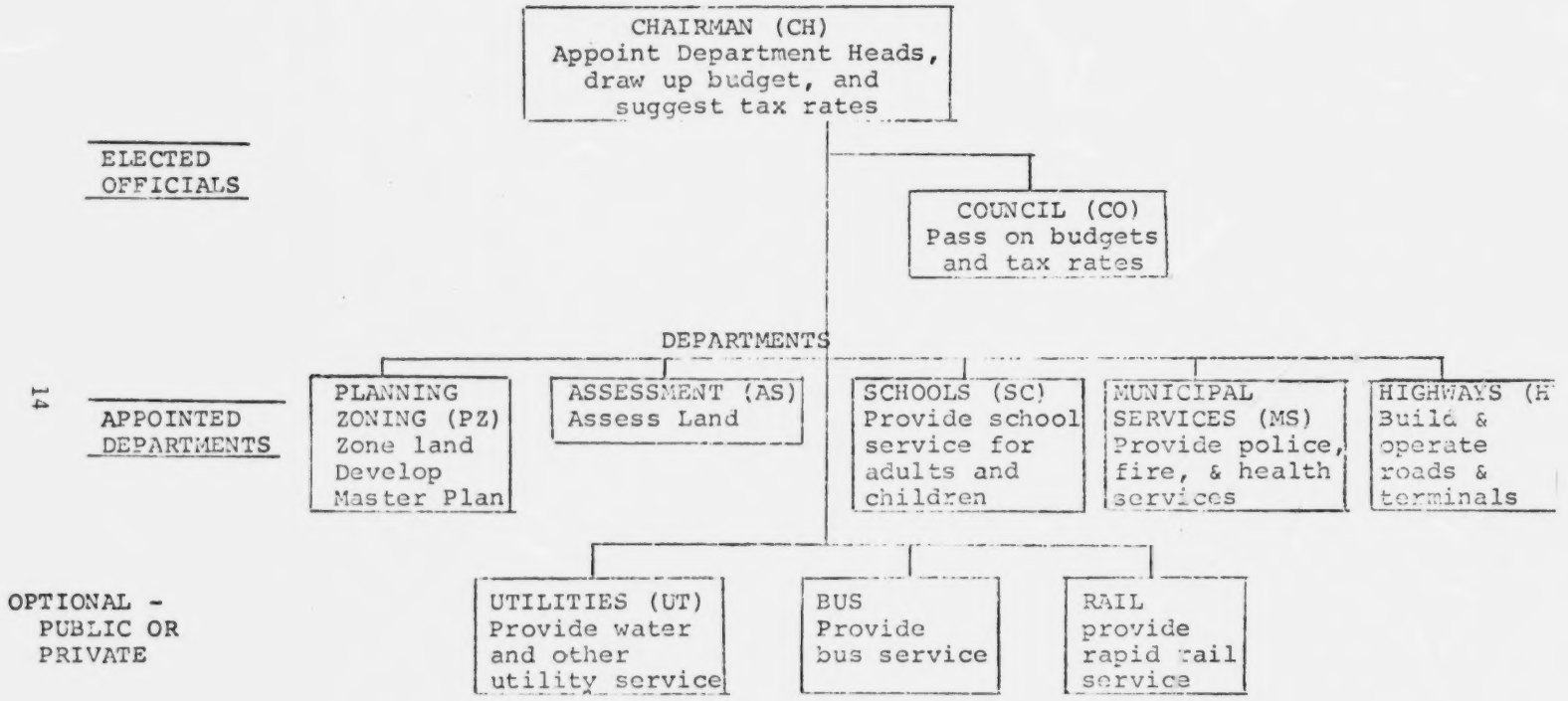
B. Sector Functions

Figure GV1 shows the government structure that may exist in each of the local systems. The Bus and Rail Departments are systemwide functions, whereas the other departments operate on a jurisdiction basis. As noted, the Chairman (or Mayor) and Council are elected in each of the jurisdictions, and the department (staff) decision-makers are appointed by the chairman. The optional public departments, Utilities, Bus and Rail are usually part of the Government Sector, as quasi public functions, but they can also be operated as private (economic) sector activities either initially or as a result of participant action (public sale). The codes used to identify the government functions are shown in parentheses after the function name in Figure GV-1.

Elected officials are accountable to the electorate (the social sector). They are required to respond to public hearings, propose and defend referenda on certain issues, and stand for election. The manner in which elected officials exercise power and conduct their administration and public affairs, however, is at their discretion.

Appointed Department representatives are responsible to the Chairman and Council. However, the presence or absence of effective leadership and communication may influence this relationship and staff decisions. The Government Sector decision-makers depend for their political life on the votes of the social sector. Their relationship with the business community is determined by their own view of public office and public service.

GOVERNMENT STRUCTURE



C. Administrative (Non-Decision) Functions

Any number of additional administrative functions can be created to approximate local structures or to examine a variety of administrative mechanisms. While these optional functions do not make direct input decisions to the computer, they may be created to have as much advisory, regulatory or "legal" influence as the participants (or Director) determine. An ENVIRONMENTAL QUALITY CONTROL Commission, for instance, could be established to act as a regulatory agency in the area of water quality and as such could influence current economic activities and future development.

D. Government Decisions

The Government Sector decisions cover a wide spectrum of municipal and public service activities. The types of possible decisions are listed in Figure GV-2, with an indication of the individual decision-makers with primary interest or responsibility. Complete descriptions are in each decision-maker's manual.

In the model, as in the real world, the government can anticipate the emergence of pressing issues related to jobs, housing, economic development, education, public transit, and the environmental quality of their region.

This issue may, for example, occur in the form of special zoning requests, substantial school budgets for adult education, or adamant citizen demands for clean water, increased recreation facilities or lower utility rates.

E. Government Output

It rarely happens that the government has all the information it wants, or needs, to make perfect decisions. Many decisions, under pressures of time, will be typical "guesstimates" - intuitive actions. It is possible, however, for each activity to develop an effective information system using the available resources in the model.

For the local system, the general output is usually posted each round and is available to all decision-makers for general information and analysis. The general output makes available to each participant, in maps, detail and summary form, extensive current and comparative information about conditions, trends and characteristics of the region. The range of information in the maps and the items of General Output cannot be overemphasized. Experience

GV-2

GOVERNMENT SECTOR DECISIONS

TYPE OF DECISION	PRIMARY INTEREST								
	CH CO	AS	SC	MS	HY	PZ	UT	BU	RA
Grant Appropriations	x								
Grant Subsidies	x								
Transfer Cash	x		x	x	x	x	x	x	x
Set Welfare Payments	x								
Set Tax Rates	x								
Float Bonds	x								
Assess Land, Buildings		x							
Buy and Sell Land			x	x	x	x	x		x
Establish Government Jobs			x	x				x	x
Establish Maintenance Levels of Government Facilities			x	x	x			x	x
Establish Service Districts			x	x			x		
Request Federal State Aid	x		x		x				
Establish Employee Salaries			x	x				x	x
Build and Demolish Schools			x						
Establish Adult Education Programs			x						
Build and Demolish Municipal Service Plants				x					
Contract to Purchase Goods and Services			x	x					
Construct and Demolish Roads					x				
Construct and Demolish Terminals					x				
Zone Land						x			
Create and Demolish Public Institutional Land Uses						x			

GV-2 (Cont.)

GOVERNMENT SECTOR DECISIONS

TYPE OF DECISION	PRIMARY INTEREST								
	CH CO	AS	SC	MS	HY	PZ	UT	BU	RA
Provide Parkland						x			
Install Utility Services							x		
Set Utility Service Prices							x		
Construct and Demolish Utility Plants							x		
Locate Public Transit Routes								x	x
Buy and Sell Rolling Stock								x	x
Set Fares								x	x
Establish Amount of Transit Service								x	x
Construct Rail Lines and Stations									x
Set Water Prices							x		
Construct Treatment Plants (intake and outflow)							x		
Specify Intake and Outflow Points							x		
Establish Water Sampling Stations									
Set Dam Priorities	x						x		

with the model has indicated that decisions are facilitated if the participants use the General Output information as part of their decision process.

The complete government sector output consists of the information, maps and detail made available to each government decision-making function of the government. Each government function has available to it a comprehensive portrayal of its status and the conditions which pertain to its activities.

F. Government Budgetary Procedures

The same general financial accounting procedure is used for all government departments, including Utilities, Bus and Rail. Department budgets are divided into Capital and Current accounts. Departments may transfer funds from one account to another, but no automatic transfers will take place. Appropriations, subsidies, and cash transfers to departments must be directed to either the capital or current account.

The Chairman's account has only a current account, the Planning and Zoning Department has only a capital account, and the Assessment Department has no financial accounts. All other departments have both accounts.

The Chairman makes appropriations, and subsidies from his current account before he actually receives income to his account. His is the only department which makes expenditures before income is calculated. Once a department has received an appropriation, the money is never automatically transferred back to the Chairman's account. If the Chairman spends more than he later receives in revenue, a current bond is automatically floated in the Chairman's name and is paid off from the Chairman's account. If a department spends more than its revenues (this can only happen in a department's current account), a current bond is floated in the department's name and is paid off from the department's account.

The following format is contained within each account:

Previous Cash Balance
Revenues
Expenditures
New Cash Balance.

If the output is for round T, then Previous Cash Balance would be equal to the New Cash Balance for round T-1.

Expenditures may not be made from capital accounts unless there is sufficient cash to cover the expenditure. Therefore, the cash balance in a capital account is always greater than or equal to zero; the cash balance in the capital account may not be negative.

If expenditures from the current account are greater than previous balance plus revenues, then a short term bond (current or two-year) is automatically floated to cover the deficit. Therefore, the New Cash Balance may never be negative in the current account. Because of rounding, the New Cash Balance will normally be slightly positive (rather than zero) even in the case where a short-term bond had to be floated.

All capital expenditures are player or director decisions which have been submitted during the previous EDIT. Current expenditures are made according to government policies which may have been established in any previous EDIT. Current expenditures (except miscellaneous expenditures) do not directly reflect player decisions; they are functions of policies. For example, a player sets the salaries and number of job openings which the School Department offers, but other local conditions influence how many employees the department actually hires and thus influence the amount which the department pays in salaries.

The most common capital revenue sources for departments are appropriations (for MS, SC, HY, and PZ), capital bonding for 25 years (all departments), Federal-State Aid (SC, HY) and miscellaneous sources (sale of land, and incoming cash transfers). Special capital revenue sources are subsidies to the Utility Department.

The most common capital expenditures are for construction, land purchase, and miscellaneous (outgoing cash transfers).

The most common current revenue sources are appropriations (all but UT and CH), short term bonding, Federal-State Aid (MS and SC), and miscellaneous income (incoming cash transfers).

Special current revenue sources exist for the Utility Department (income from user charges on utility and water service and subsidies) and the Chairman (taxes).

The most common current expenditures are for bond payments (capital bonds and current bonds together), goods and services (MS, SC, maintenance for HY, and utility operating costs for UT), salaries (MS and SC), and miscellaneous (outgoing cash transfers).

Special current expenditures are for welfare payments (MS), adult education (SC), treatment operating costs and sampling station operating costs (UT), and subsidies (CH).

G. GOVERNMENT MASTER TABLE
(Characteristics are for Level One Development)

	SC	MS	UT	HY	TM	RAIL STATION	RAIL TRACKS (Per Mi) SURFACE	UNDER-GROUND	VEHICLES RAIL	VEHICLES BUS
CONSTRUCTION COST (Millions of Dollars)	27	30	30	.8M	14	1	4	NA	.8/mi	.4/mi
DEMOLITION COST (Millions of Dollars)	5.4	6	6	.16M	2.8M	NA	NA	NA		
CHARACTERISTICS OF FACILITIES										
Possible Levels of Development	3	3	3	3	3	1	1	1		
Land Requirement (% of a parcel)	16	12	20	8	12	NONE	4	NONE		
Rate of Annual Depreciation (%)	2.0	3.3	NA	5.0	NA	NA	NA	NA	3.5	3.5

	SC	MS	UT	HY	RAIL	BUS	PZ
POSSIBLE SOURCES OF REVENUE TO DEPARTMENTS							
Current Funds							
Appropriations	x	x		x			
Subsidy			x		x	x	
Cash Transfer	x	x	x	x	x	x	
Automatic Bonding	x	x	x	x	x	x	
Automatic Federal State Aid	x	x					
Capital Funds							
Appropriations	x	x		x			x
Subsidy			x		x	x	
Cash Transfer	x	x	x	x	x	x	x
Bonding	x	x	x	x	x	x	x
Federal-State Aid	x			x			
Charges to Users			x		x	x	
Labor Hired	PH PM	PM PL	NA	NA	PM	PM	NA

III. SCHOOL DEPARTMENT

A. Introduction

This manual contains the basic information and description of the model required by the School Department. It is assumed that the Model Overview, the Scenario, and the Government Sector descriptions have been read prior to the receipt of this manual.

Once the players comprising the School Department have become familiar with the model in general, the particular city being represented, and the workings of the local educational system they will be able to bring their own imagination and initiative to bear on the operation of the School Department in their specific jurisdiction.

The local School Department is given control of a number of educational resources within the local dynamic system and it will have the opportunity to allocate these resources and change them in such a way as to satisfy self-established goals and/or to respond to pressures brought on it by elected officials and the local citizenry and business community.

B. School Department Summary

The School Department provides education for adults in the local jurisdictions. It is a dependent school system in that it receives appropriations from the chairman of the local jurisdiction. It may not levy its own taxes, but it may float bonds for capital projects with approval from the social sector through a referendum.

The department makes capital expenditures when expanding its educational facilities. Each new level of educational facilities requires a specified amount of land (which must be acquired) and costs a specified dollar amount. Current expenditures must be made each round to pay teachers salaries, purchase needed goods and services, and pay off bonds.

Each school facility has an associated school district comprised of parcels of land that is delineated by the department. The children from all population units living within a school district will attend the local public schools if there is adequate space and a certain level of quality education. School quality is viewed differently by the three income classes, but they base their decisions on the quality of the school facility itself; the ratio of teachers to students, and the ratio of high-income teachers to middle-income teachers. The quantity and quality of local public school services for a district is therefore dependent upon the level of the school facility, its value ratio, and the number of P1's hired from the high and middle class, and the school crowding.

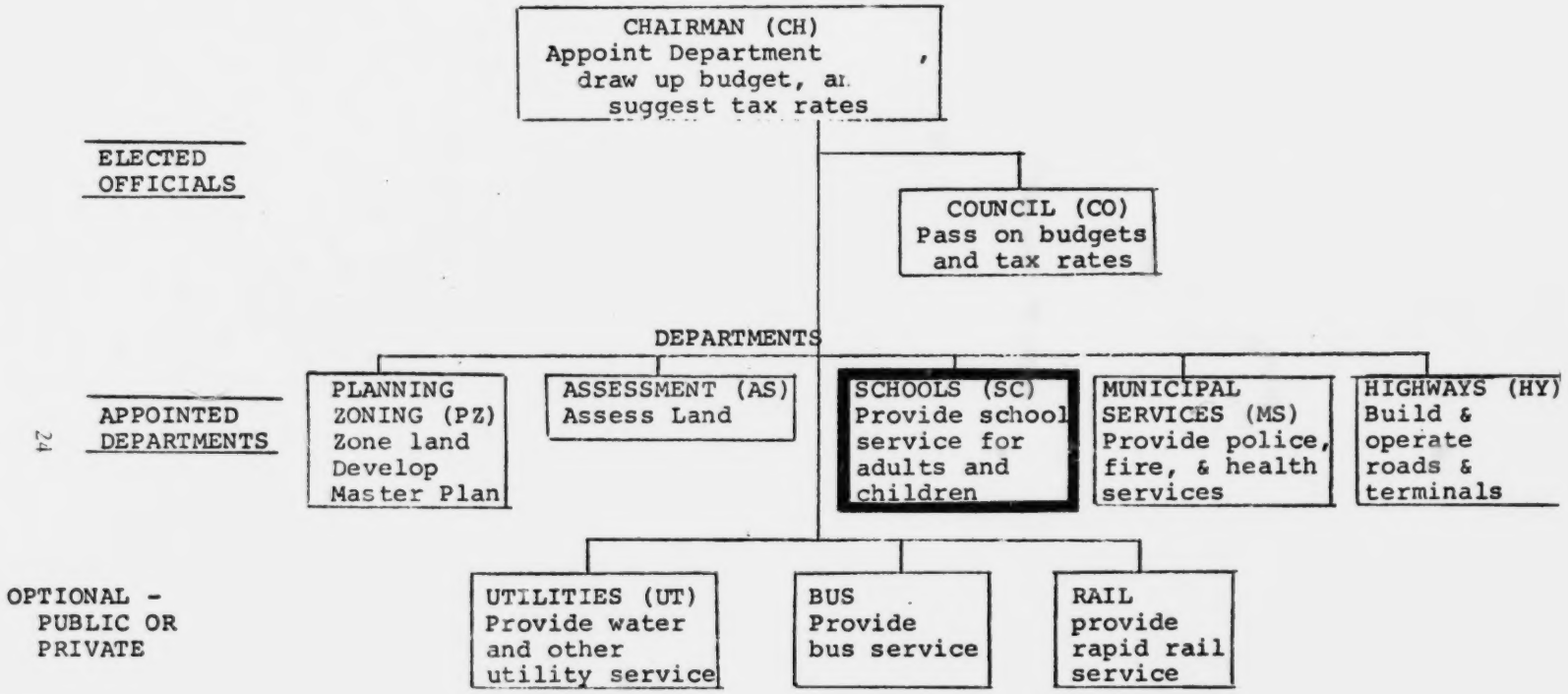
The demand for school services within a district is dependent upon the number and class of population units located within the boundaries of the school district.

An overall index of the quality of school services within a school district is derived from the ratio of the school units demanded to the school units supplied. This ratio is multiplied times 100 to arrive at a School Use Index. As the Use Index rises above 100, the quality of service declines. This impacts on population units by making their neighborhood dissatisfaction increase.

The School Department may also supply adult education facilities for the local population in its jurisdiction. The supply of adult education service is dependent upon the number of teachers hired for the adult education program. The demand for adult education services is dependent upon the time allocations by the social sector for public adult education.

Figure SC-1

THE SCHOOLS DEPARTMENT AS IT FITS
WITHIN THE LOCAL GOVERNMENT STRUCTUPE



IV. COMPUTER PRINTED OUTPUT DESCRIPTION

A. Introduction

The printed computer output provides a yearly report of the status of the simulated region and of interactions within the region during the previous year. There are several types of output: maps showing characteristics of the region which differ geographically; summaries which present information in capsulated form; and detailed information from which the summaries are derived.

The figure on the next page shows the titles of the output sections in the order in which they are printed. That sequence follows neither the logical order of computer program operations nor the usual sequence in which a user examines the output. The code number beside the title of each section of output listed in this figure is the code number used in all examples of output included in this manual. The output is explained in this section in order of most general to most detailed information. Output is explained in the following order:

- maps
- summary information
- general information of relevance to all three sectors
- social sector detail
- economic sector detail
- government sector detail

There are a few standard features of all printed output sections. Each has a title which is a short description of the type of information given by the section of output. Each also contains both the round number and the game heading (the name of the data base being used or some other heading input by the director). Where relevant, a jurisdiction number is also printed.

After a few rounds' experience with the model, a model user usually needs only the printed computer output from a round and the Master Tables and input formats contained in this manual in order to play subsequent rounds.

RIVER BASIN MODEL OUTPUT

1. Migration
   - 1.1 Environmental Indexes
   - 1.2 Personal Indexes
   - 1.3 Dissatisfaction Cutoffs
   - 1.4 Migration Detail
   - 1.5 Migration Statistics
   - 1.6 Migration Summary

2. Water System
   - 2.1 Water User Effluent Content
   - 2.2 River Quality During Surface Water Process
   - 2.3 Water User Costs and Consumption
   - 2.4 Coliform and Pollution Index Values

3. Employment
   - 3.1 Employment Selection Information for PL Class
   - 3.2 Employment Selection Information for PM Class
   - 3.3 Employment Selection Information for PH Class
   - 3.4 Part-Time Work Allocation for PH Class
   - 3.5 Part-Time Work Allocation for PM Class
   - 3.6 Part-Time Work Allocation for PL Class
   - 3.7 Employment Summary

4. Commercial Allocation
   - 4.1 Personal Goods Allocation Summary
   - 4.2 Personal Services Allocation Summary
   - 4.3 Business Goods Allocation Summary
   - 4.4 Business Services Allocation Summary
   - 4.5 Government Contracts
   - 4.6 Terminal Demand and Supply Table
   - 4.7 Terminal Allocation Map

5. Social Sector
   - 5.1 Dollar Value of Time
   - 5.2 Social Decision-Maker Output
   - 5.3 Social Boycotts

6. Economic Sector
   - 6.1 Farm Output
   - 6.2 Residence Output
   - 6.3 Basic Industry Output
   - 6.4 Commercial Output
   - 6.5 Economic Boycott Status
   - 6.6 New Construction Table
   - 6.7 Land Summary
   - 6.8 Loan Statement
   - 6.9 Financial Summary

7. Social and Economic Summaries
   - 7.1 Number of Levels of Economic Activity Controlled by Teams
   - 7.2 Employment Centers
   - 7.3 Economic Control Summary for Teams
   - 7.4 Social Control Summary for Teams
   - 7.5 Social Control Summary Totals
   - 7.6 Economic Graphs for Teams
   - 7.7 Social Graphs for Teams

8. Government Detail
   - 8.1 Assessment Report
   - 8.2 Water Department Reports
   - 8.3 Sampling Station Report: Point Source Quality
   - 8.4 Sampling Station Report: Ambient Quality
   - 8.5 Utility Department Report
   - 8.6 Utility Department Finances
   - 8.7 Municipal Services Department Report
   - 8.8 Municipal Services Department Finances
   - 8.9 Municipal Services Department Construction Table
   - 8.10 Planning and Zoning Department Report
   - 8.11 School Department Report
   - 8.12 School Department Finances
   - 8.13 School Department Construction Table
   - 8.14 Highway Department Finances
   - 8.15 Highway Department Construction Table
   - 8.16 Rail Company Report
   - 8.17 Bus Company Report
   - 8.18 Chairman Department Finances
   - 8.19 Tax Summary
   - 8.20 Financial Summary

9. Summary Statistics
   - 9.1 Demographic and Economic Statistics

10. Maps
   - 10.1 Personal Goods Allocation Map
   - 10.2 Personal Services Allocation Map
   - 10.3 Business Commercial Allocation Map
   - 10.4 Municipal Service Map
   - 10.5 School Map
   - 10.6 Utility Map
   - 10.7 Water Usage Map
   - 10.8 Water Quality Map
   - 10.9 Municipal Treatment
   - 10.10 Municipal Intake and Outflow Point Map
   - 10.11 Surface Water Map
   - 10.12 Farm Runoff Map
   - 10.13 River Basin Flood Plain Map
   - 10.14 Farm Map
   - 10.15 Farm Assessed and Market Value Map
   - 10.16 Market Value Map
   - 10.17 Assessed Value Map
   - 10.18 Economic Status Map
   - 10.19 Highway Map
   - 10.20 Planning and Zoning Map
   - 10.21 Parkland Usage Map
   - 10.22 Socio-Economic Distribution Map
   - 10.23 Demographic Map
   - 10.24 Social Decision-Maker Map
   - 10.25 Topographical Restriction Map
   - 10.26 Government Status Map

Reproduced from best available copy.

B. Map Output

The model output includes several maps which visually represent characteristics of the simulated region which differ by location. The entire simulated region is represented on a single, two-page computer map. A map key is printed at the bottom of each page. Map symbols appear on a map in the three types of locations which can be specified in the model: parcels (squares), parcel edges (lines separating squares), and intersections of lines (parcel corners). Land uses and other characteristics of parcels are represented within the squares. Divisions between parcels such as roads or jurisdiction boundaries are represented between parcels, and activities such as terminals are represented at parcel corners.

The Map Titles and a brief description of their contents are given below, in the order in which they will be discussed. All information is located spatially.

Economic Status Map: economic owners, economic activities and operating levels, zoning, levels of utilities installed, amounts of undeveloped land, road types, terminal levels, jurisdiction boundaries.

Government Status Map: school levels, parks, municipal service levels, utility plant levels, road types, terminal levels, jurisdiction boundaries.

Socio-Economic Distribution Map: residence types and levels, number of PI's of each class, road types, terminal levels, jurisdiction boundaries.

Demographic Map: populations, residential quality indexes, business value ratios, percent occupancy, road types, terminal levels, jurisdiction boundaries.

Personal Goods Allocation Map: PG shopping location for each class and residence, PG location.

Personal Services Allocation Map: PS shopping location for each class and residence, PS location.

Business Commercial Map: BG and BS shopping location for each business, BG and BS locations.

Utility Map: utility units served, utility units installed, utility plants, utility district boundaries, jurisdiction boundaries.

Surface Water Map: volumes of surface water, rates of flow, land area in water, directions of surface water flow, lakes.

Municipal Treatment Plant Map: municipal water intake treatment plants and levels, municipal sewage treatment plant types and levels, utility plant locations and code numbers, directions of surface water flow, utility district boundaries, lakes.

Municipal Inflow and Outflow Point Map: Municipal surface water intake points, municipal sewage outflow points, utility districts served by each, surface water qualities, directions of surface water flow, utility district boundaries, lakes.

Water Quality Map: economic activities and operating levels, surface water qualities, directions of surface water flow, lakes.

Economic Sector Water Usage Map: economic activities and operating levels, amounts of recycling, business effluent treatment types and levels, utility district boundaries, jurisdiction boundaries.

Municipal Services Map: economic activities and operating levels, municipal service units required, municipal services and their use indexes, municipal service district boundaries, jurisdiction boundaries.

School Map: numbers of public school students, numbers of private school students, schools and their use indexes, school district boundaries, jurisdiction boundaries.

Highway Map: economic activities and operating levels, road types, terminal levels.

Planning and Zoning Map: zoning, park, public institutional land uses, road types, terminal levels, jurisdiction boundaries.

Parkland Usage Map: parks, populations served by park, park use indexes, road types, terminal levels, jurisdiction boundaries.

Market Value Map: market values of all non-farm land, privately owned buildings, and privately owned land and buildings, road types, terminal levels, jurisdiction boundaries.

Assessed Value Map: assessed values of non-farm privately owned land and buildings, road types, terminal levels, jurisdiction boundaries.

Farm Assessed and Market Value Map: assessed and market values of farms, amount of land in farms, road types, terminal levels, jurisdiction boundaries, lakes.

Farm Map: farm owners, amount of land in farms, farm types, levels of fertilization, road types, terminal levels, jurisdiction boundaries.

Farm Runoff Map: where runoff from farms flows, direction of surface water flow, lakes.

River Basin Flood Plain Map: river basins, dam priorities, flood susceptibility of each parcel, direction of surface water flow, lakes, jurisdiction boundaries.

Topographical Restriction Map: topographically undevelopable land, road types, terminal levels, jurisdiction boundaries.

Social Decision-Maker Map: social decision-maker controlling each class living on each residence parcel, road types, terminal levels, jurisdiction boundaries.

1. Economic Status Map

This map shows the economic sector owners of all privately-owned non-farm parcels and the economic activity, if any, on each parcel. A parcel can have only one economic owner and one economic activity. Owners of farm parcels are shown on the Farm Map. The types of economic activities represented in the model are listed in the Master Tables.

The economic owner of a parcel owns all of the land and developments on the parcel which do not belong to the government or which are not topographically undevelopable. If the economic owner sells land to another economic decision-maker, he must sell all of the privately-owned land and buildings on the parcel to the new owner. An economic decision-maker can sell any portion of undeveloped land on a parcel to a government department.

The Planning and Zoning Department may zone parcels. Zoning is a restriction on economic development. Once a parcel is assigned a particular zoning code, all new economic development on the parcel must conform to the new zoning. If a parcel is unzoned, there is no restriction on what type of activity may be constructed on it. The Economic Status Map key defines what private land uses are allowed under each zoning code.

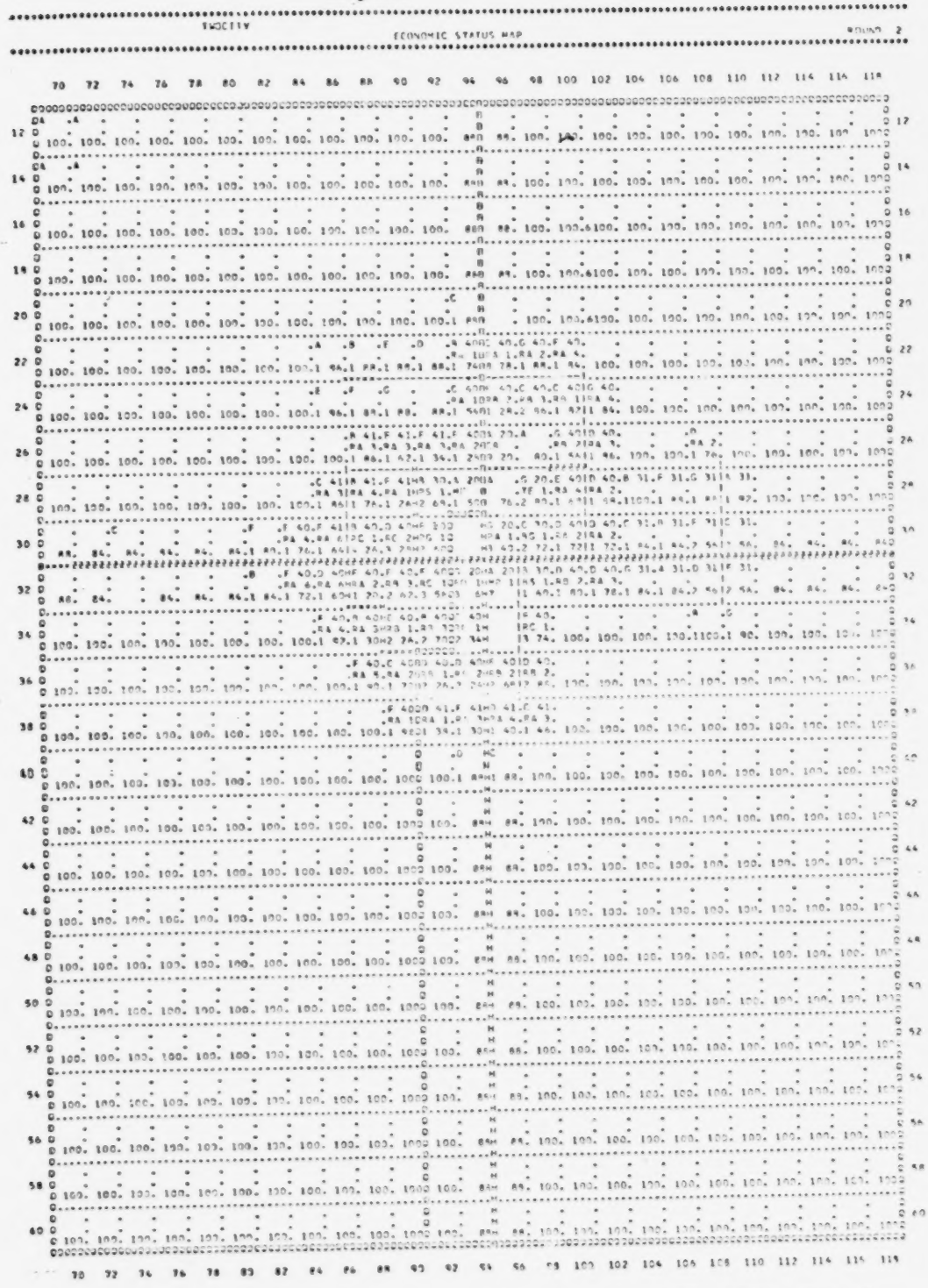
When a new economic development is constructed on a parcel, it must not only conform to the parcel's zoning; it must have sufficient utility service. Utilities are installed by the Utility Department in "levels" (1 - 9). Each level of economic activity requires a certain number of utility units, and each level of utility service supplies a fixed number of utility units to a parcel.

If an economic decision-maker has insufficient utility service for a proposed development, the Utility Department must install adequate utility service before the new development can be constructed.*

---

*There are two exceptions to the utility restriction on development: 1) RA housing can be built with "private utilities", which do not require utilities supplied by the Utility Department; 2) the director can override the utility restriction on individual developments.

Figure 10.18


TWOCITY
ECONOMIC STATUS MAP
ROUND 2
PARCEL KEY
TOP LEFT: OWNER
TOP RIGHT: ZONING
MIDDLE: LAND USE AND LEVEL
BOTTOM LEFT: UTILITY LEVEL
BOTTOM RIGHT: % UNDEVELPD LAND
PARCEL EDGES
== == FREEWAY
-- || TYPE 1 ROAD
== HH TYPE 2 ROAD
// == TYPE 3 ROAD
CO CO JURISDICTION BOUNDARY
INTERSECTIONS
+ TYPE 1 TERMINAL
X TYPE 2 TERMINAL
TYPE 3 TERMINAL
ZONING LAND USE
ZONING USE
31 MF
32 RG

Economic developments also require land. Each activity, depending on its type, requires a certain amount of land for each constructed level of development. Regardless of the operating level of an activity, the land consumed is that of the constructed level, which is always greater than or equal to the operating level. The amount of privately-owned land which is not in developments is classified on this map as undeveloped. If a parcel shows no undeveloped land, no further economic development can occur there unless the owner either acquires more land from a government department owning a portion of the parcel or demolishes existing economic developments. An economic decision-maker can acquire land by purchasing a parcel from another economic decision-maker or by bidding on land which is owned by the Outside.

The operating level of an economic activity is shown on the Economic Status Map. For most purposes, a business' operating level is the only level considered by the computer programs. However, a business pays property taxes and maintenance for its constructed level.

2. Government Status Map

Whereas there can be only one economic owner per parcel, any combination of government departments can own developed and undeveloped land on a parcel. The government departments which can own land, and the types of developments each can construct on a parcel are:

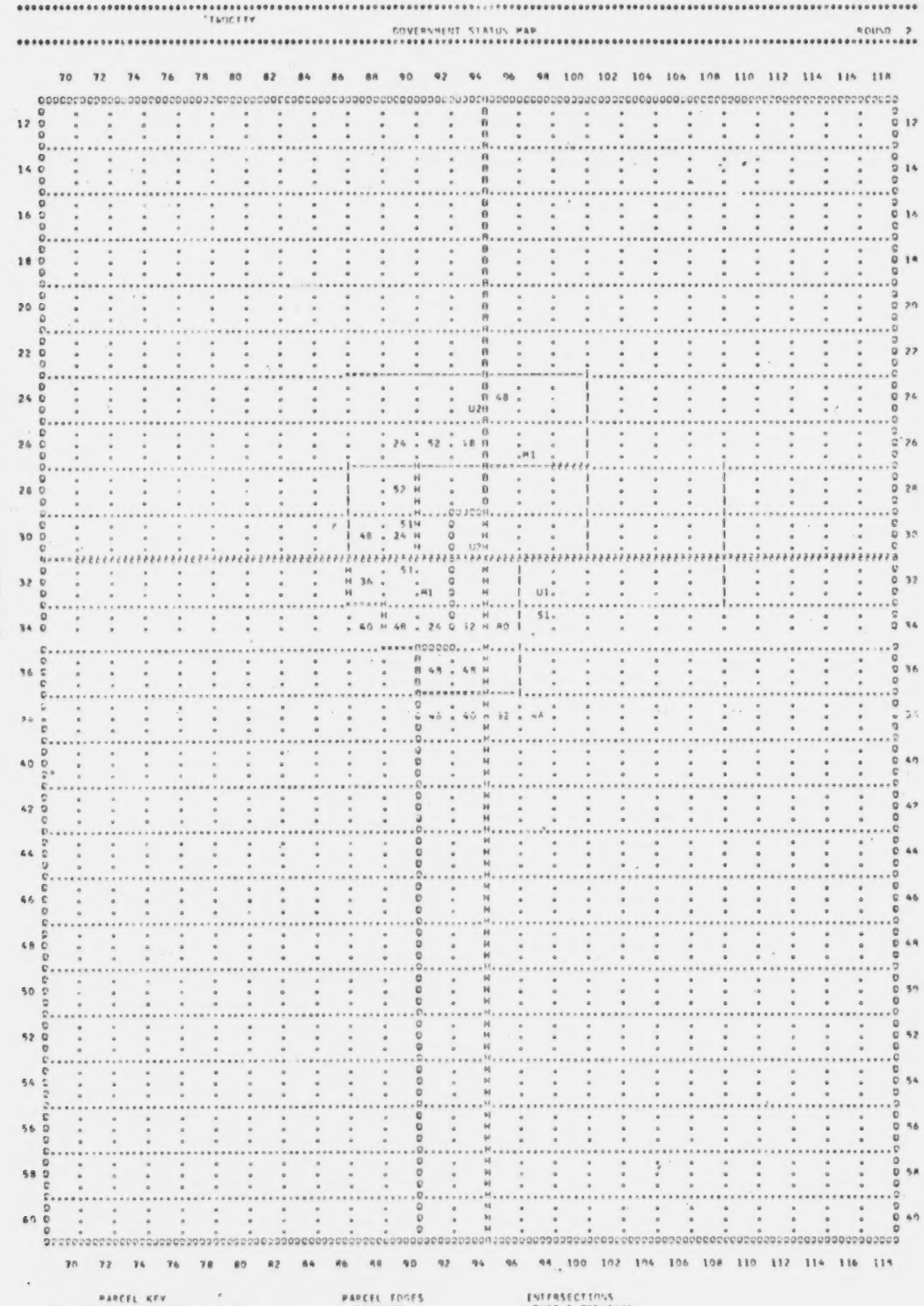
Department	Development Type
Utility Department	Utility Plant Water Intake Treatment Plant Sewage Outflow Treatment Plant: Chlorination Primary Treatment Secondary Treatment Tertiary Treatment
School Department	School Unit
Municipal Service Department	Municipal Service Unit
Planning and Zoning Department	Parkland Public Institutional Land
Highway Department	Road* Terminal*

A government department can sell undeveloped land which it owns to either another government department or to the economic decision-maker owning the privately-owned portion of a parcel.

The government status map shows the locations of some of the types of government activities: schools, parks, utility plants, and municipal service units.

*A road requires land from the parcels on each side, and a terminal requires land from the four parcels touching the intersection at which it is located.

Figure 10.26



Reproduced from best available copy.

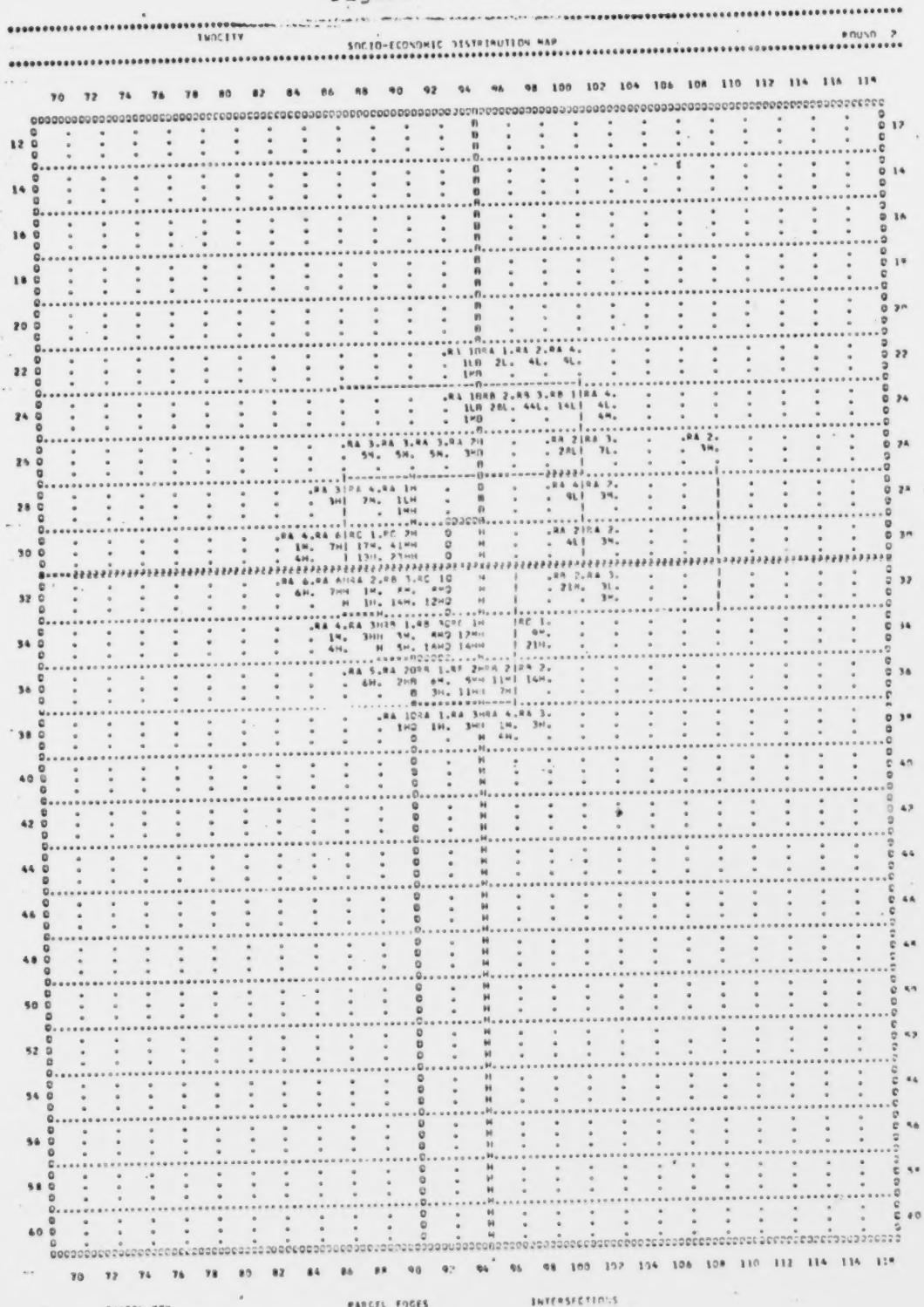
3. Socio-Economic Distribution Map

This map shows the number of P1's of each class living on each residence parcel. The residence type and level are also printed.

The migration process allocates people to housing. Only two classes can live on a residence parcel simultaneously, due in part to the model's restriction that a PH will not move into a residence with a quality index below 71 and a PL will not move into housing with a quality index above 70. It is possible, if a residence depreciates below the minimum that a class will accept, that high-income, for example, will live in a residence with a quality index below 71 if the class was living on the parcel before the depreciation. In no case, however, can PH's reside on the same parcel with PL's.

Each level of a residence type provides a fixed number of space units. A P1 occupies a fixed number of space units, depending on its class. The percent occupancy of each residence is shown on the Demographic Map.

Figure 10.22


TMOCITY
SOCIO-ECONOMIC DISTRIBUTION MAP
ROUND 2
PARCEL KEY
TOP ROW: RESIDENCE TYPE AND LEVEL
MIDDLE ROW: NUMBER OF PEPS AND CLASS
BOTTOM ROW: NUMBER OF PEPS AND CLASS
PARCEL EDGES
== == BOARDED
-- -- TYPE 1 ROAD
== == TYPE 2 ROAD
== == TYPE 3 ROAD
OO OO JURISDICTION BOUNDARY
INTERSECTIONS
+ TYPE 1 TERMINAL
X TYPE 2 TERMINAL
* TYPE 3 TERMINAL

4. Demographic Map

The demographic map shows the number of people living on each residence parcel, the percent occupancy of each residence and the quality of all privately owned buildings and equipment.

Overcrowding (over 100% occupancy) contributes to a residence's neighborhood index and to the health index.

The quality is expressed as the quality index for a residence and as the value ratio for non-residential activities. A value ratio is the ratio of the present condition of a business' buildings and equipment to their original condition, expressed as a percent.

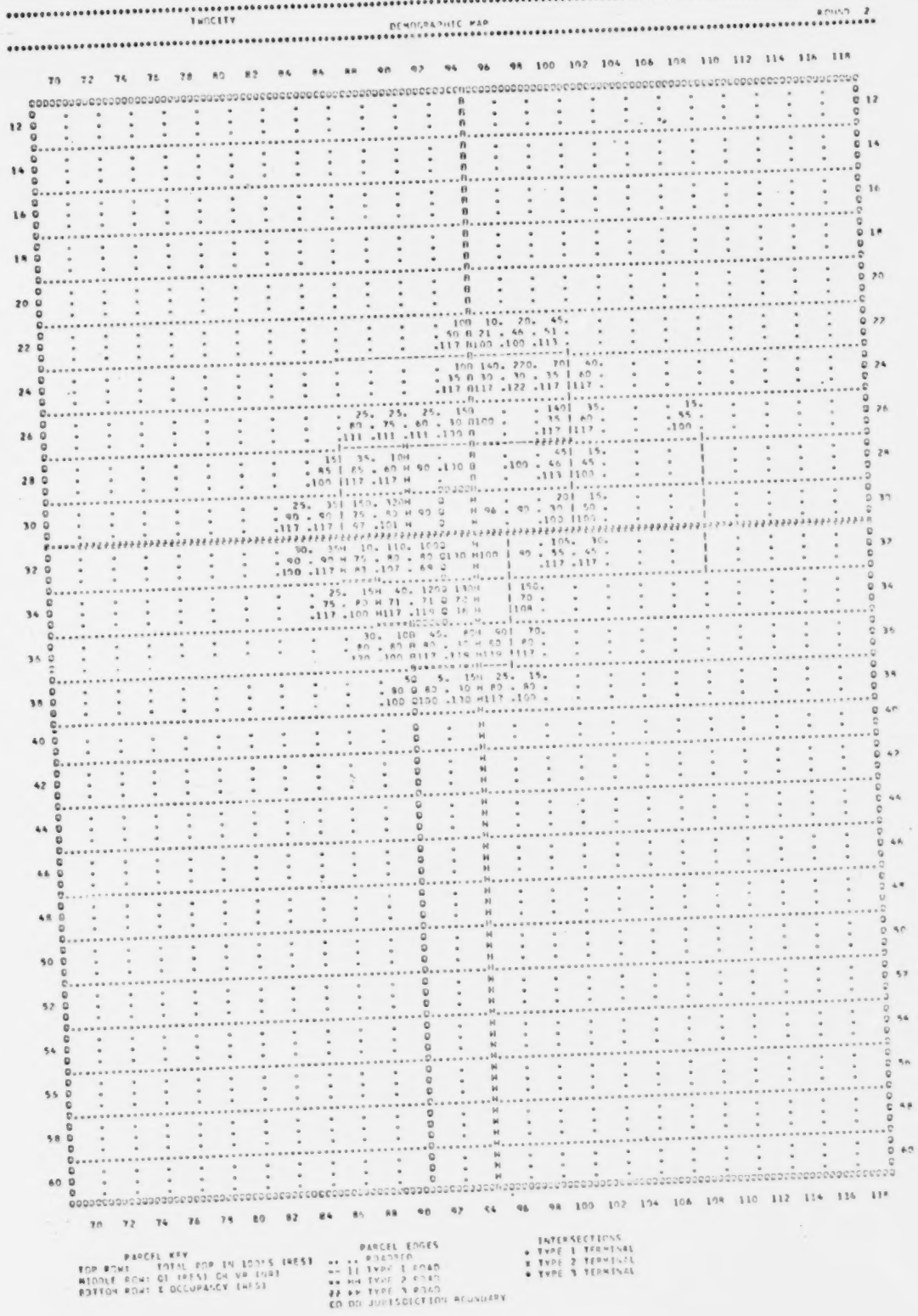
A quality index is somewhat different. Whereas a new business has a value ratio of 100, a new residence can have a quality index from 40 to 100.

Each year buildings and equipment depreciate in response to several conditions which vary by type of activity (see the Master Tables for the causes of depreciation). A business's depreciation is measured as a percent of original value (100). A residence's depreciation is measured as a percent of the original value of such a type of residence originally built at a quality index of 100, regardless of the original quality of the specific residence. Thus, business depreciation is a percent of original value but residential depreciation is a percent of quality index 100.

The owner of an activity can set a maintenance level for the activity. The maintenance level is the quality index or value ratio at which the owner will maintain the activity, regardless of how much it depreciates in a year. Not until the activity's value ratio or quality index falls to its maintenance level does the owner incur maintenance expenditures. The computer program depreciates and maintains buildings and equipment and charges the owner for the maintenance cost.

The Demographic Map shows quality indexes and value ratios after depreciation and after any maintenance.

Figure 10.23

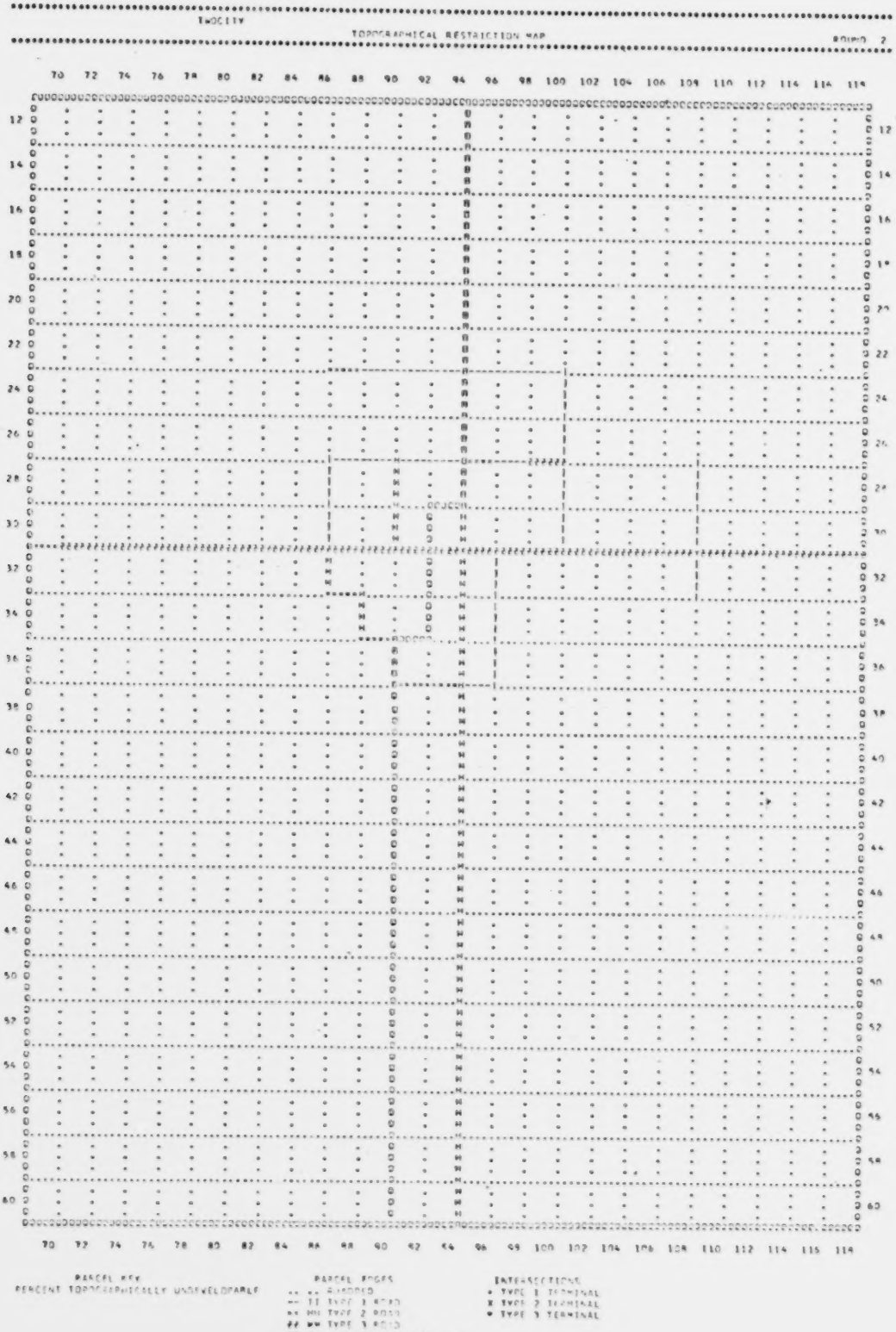


Reproduced from best available copy.

5. Topographical Restriction Map

This map shows the percent of a parcel that may not be purchased or developed by any local decision-makers. Land that is topographically undevelopable includes mountains, rock outcrops, swamps. None of the area consumed by water bodies represented in the local system (large lakes, small lakes, and rivers) is shown on this map. The map also shows jurisdictional boundaries, the road network, and the location of terminals.

Figure 10.25

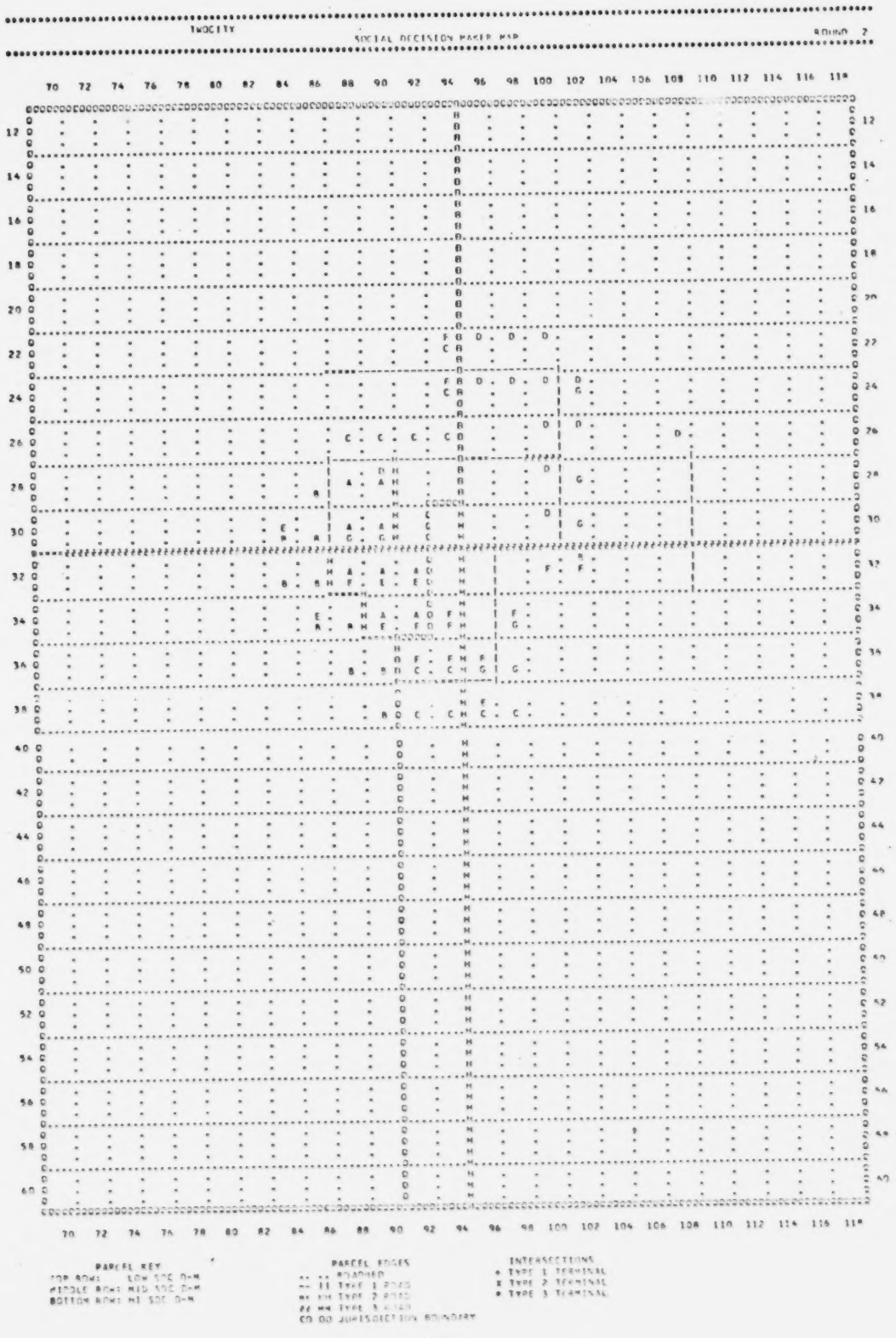

TWOCITY
TOPOGRAPHICAL RESTRICTION MAP
ROUND 2
PARCEL KEY
PERCENT TOPOGRAPHICALLY UNDEVELOPABLE
PARCEL CODES
INTERSECTIONS
* TYPE 1 TERMINAL
X TYPE 2 TERMINAL
+ TYPE 3 TERMINAL

6. Social Decision Maker Map

This map indicates which social players make decisions for the low, middle, and high income population units on parcels. The top letter on a given parcel represents the social decision-maker who controls the PL's who live there, and the middle and lower letters represent the social decision-makers who control the PM's and PH's, respectively, who live there. If a particular class does not live on a parcel, no letter is printed.

Not until a parcel is developed for residential land use and occupied by at least one income class, will a social decision-maker for that parcel appear on the map. Note that different decision-makers may control the different population classes on a single parcel. Social teams acquire control over additional Pl's on a parcel when the number of Pl's of that class moving into the parcel exceeds the number moving out. Social teams may find that from round to round they gain or lose control of population units on a residential parcel of land. This occurs as a result of the migration of Pl's of a class to a parcel where previously there were no Pl's of that class (a gain) or as a result of the migration away from a parcel of all the Pl's of a class on that parcel.

Figure 10.24


TWOCITY
SOCIAL DECISION MAKER MAP
ROUND 2
PARCEL KEY
PARCEL EDGES
INTERSECTIONS
* TYPE 1 TERMINAL
# TYPE 2 TERMINAL
+ TYPE 3 TERMINAL

C. Summary Information

1. Demographic and Economic Statistics

The output summarizes a wide variety of information about the simulated region. There are two basic types of information: statistics by jurisdiction and for the region as a whole about local conditions, and measures of interactions between the region and the Outside System. The former provide comparisons between jurisdictions; the latter provide comparisons between the local and Outside systems.

Statistics Regarding Local Conditions

Total population: the number of people (not Pl's), by class.

Percent change over previous year: the total population change, positive or negative, between the current round and the previous round. This is the only local statistic which is given only as a total and not broken down by jurisdiction.

Average population per parcel: the number of people divided by the number of parcels.

Developed land (in parcels): the amount of land area (in parcel equivalents) consumed by public and private developments.

Undeveloped land: the amount of land area (in parcel equivalents) not consumed by developments.

Total land area: the number of parcels.

Assessed value of land in millions: the property tax base.

Assessed value of developments in millions: the development tax base.

Average quality of life index: a measure across classes of the people's average quality of life index. The higher the index, the poorer the quality of life. The indexes may differ significantly within a jurisdiction, but only averages are given here.

Number of registered voters: the number of people eligible to vote, from which the number who actually vote are selected.

Figure - 9.1

TWOCITY DEMOGRAPHIC AND ECONOMIC STATISTICS ROUND 1

	TOTAL	JURISDICTION I	JURISDICTION II	JURISDICTION III
TOTAL POPULATION	275500	126000	149500	0
LOW CLASS	73500	0	73500	0
MIDDLE CLASS	99000	64000	35000	0
HIGH CLASS	103000	62000	41000	0
PERCENT CHANGE OVER PREVIOUS YEAR	0			
AVERAGE POPULATION PER PARCEL	0	0	0	0
DEVELOPED LAND (IN PARCELS)	77	30	46	0
UNDEVELOPED LAND	548	266	283	0
TOTAL LAND AREA	625	296	329	0
ASSESSED VALUE OF LAND IN MILLIONS	12312.	5321.	6992.	0.
ASSESSED VALUE OF DEVELOPMENTS IN MILLIONS	421.	158.	264.	0.
AVERAGE QUALITY OF LIFE INDEX	69	61	75	0
NUMBER OF REGISTERED VOTERS	88573	45566	43007	0
NO. IN PUBLIC ADULT EDUCATION	0	0	0	0
AVERAGE EDUCATIONAL LEVEL	59	73	47	0
LOW	17	0	17	0
MIDDLE	61	61	62	0
HIGH	5232824	4061270	278305	0
NO. OF WORKERS RECEIVING WELFARE	12800	0	12800	0
STUDENT/TEACHER RATIO	7	13	10	0
SCHOOL ENROLLMENT	48740	34040	14700	0
PUBLIC	20460	0	20460	0
PRIVATE				
HOUSING UNITS	100	62	38	0
SINGLE DWELLINGS	24	7	17	0
MULTIPLE DWELLINGS	6	4	2	0
HIGH RISE APARTMENTS				
VACANCY RATE (PERCENT)	4	28	-23	0
NEGATIVE MEANS OVERCROWDED				

Figure - 9.1 (Cont'd)

NUMBER OF EMPLOYED WORKERS	79400	35360	44040	0
LOW	23000	0	23000	0
MIDDLE	31680	20480	11200	0
HIGH	24720	14880	9840	0
NUMBER EMPLOYED IN				
LIGHT INDUSTRY	27160	10240	16920	0
HEAVY INDUSTRY	27760	11800	15960	0
NATIONAL SERVICES	0	0	0	0
CONSTRUCTION INDUSTRY	0	0	0	0
BUSINESS GOODS	2800	1680	1120	0
BUSINESS SERVICES	5240	0	5240	0
PERSONAL GOODS	3360	3360	0	0
PERSONAL SERVICES	5680	2480	3200	0
MUNICIPAL SERVICES	1920	1920	0	0
SCHOOLS	3880	3880	0	0
RAIL	0	0	0	0
BUS	0	0	0	0
FEDERAL-STATE	1600	0	1600	0
NUMBER OF UNEMPLOYED WORKERS	6400	0	6400	0
LOW	6400	0	6400	0
MIDDLE	0	0	0	0
HIGH	0	0	0	0
UNEMPLOYMENT RATE (PERCENT)	7.46	0.0	12.69	0.0
LOW	21.77	0.0	21.77	0.0
MIDDLE	0.0	0.0	0.0	0.0
HIGH	0.0	0.0	0.0	0.0
PERCENT EARNING UNDER $ 5,000	33	5	55	0
PERCENT EARNING $5,000 TO $10,000	37	54	22	0
PERCENT EARNING OVER $10,000	29	39	21	0

Number in public adult education: the number of people who wanted to participate in public adult education programs and were able to do so because programs were provided by their school departments.

Average educational level: by class, the average educational level. This ranges from 0 to 100. The higher a worker's educational level relative to those of other workers, the greater his chances of being hired before the others.

Number of workers receiving welfare: if a jurisdiction does have a program for aid to the unemployed, this number is the number of unemployed workers. The number is zero if there are either no unemployed workers or no welfare program.

Student/teacher ratio: ratio of number of students attending local public schools to number of teachers employed by public schools. This is a factor when students are allocated to public or private schools.

School enrollment: the number of students attending local public schools and the number attending private schools. Students attend private schools only if the public schools in their districts are inadequate.

Housing units: the number of levels of RA (single family), RB (town house, multiple dwellings), and RC (high rise) housing.

Vacancy rate: the ratio of existing housing space to housing space occupied, expressed as a percent. A negative rate means that housing is overcrowded.

Number of employed workers: the number of people holding full-time jobs, by class of worker.

Number employed by type of employer: the number of full-time workers employed by each type of business and government employer.

Number of unemployed workers: by class, the number of workers seeking full-time employment who were unable to obtain jobs.

Unemployment rate (percent): by class, the number of unemployed workers as a percent of the total number of workers who sought full-time jobs.

Earning distribution: the percent of workers earning less than $5,000, between $5,000 and $10,000, and over $10,000 from full-time employment.

Transactions With the National Economy

Income from the national economy: federal-state aid received, by type of aid, and income from both basic industry sales of output and bus and rail sales of equipment.

Sales to the national economy: federal-state taxes paid, by type of tax, and purchases of goods, services, and outside-owned land. The only Outside expenditure which can be significantly controlled locally is the purchase of goods and services due to local insufficiency.

National economy business cycle: last round's ratio to "typical income"per unit of output for basic industry, interest rates on loans and bonds from the Outside (expressed as percents), and the average rate of return on outside investments (expressed as percents).

D. COMPUTER OUTPUT EXPLANATION FOR THE SCHOOL DEPARTMENT

The School Department for each jurisdiction receives four sections of computer output: the SCHOOL DEPARTMENT REPORT, the CONSTRUCTION TABLE, and SCHOOL DEPARTMENT FINANCES, SCHOOL MAP.

1. School Department Report

This report information is divided into five sections:

a. School Units - supply, demand and use index for each school district.

b. Undeveloped Land - location and amount of undeveloped land owned by the department.

c. Contracts - contractural agreements to purchase business goods and services from specific suppliers.

d. Adult Education - supply of and demand fro adult education programs.

e. Boycotts - information on social classes boycotting School Department jobs.

1. Characteristics of School Facilities

The first column gives the numerical identification of the School facility. Each facility in the local system is given a unique identification number that is used on the computer maps.

The second column gives the parcel location of the School facility. The third column provides the development level of the School facility. These facilities may be built or upgraded to one of three levels.

The fourth column gives the maintenance level for the school facilities. The department may change the maintenance level for any school facility. The maintenance level is the lowest level to which the value ratio will be allowed decline before maintenance expenditures are incurred.

The fifth column is the value ratio for each school facility. The value ratio is a measure of the present value and effectiveness of the plant and equipment in relation to "brand new" plant and equipment. A value ratio of 80 means that the effective capacity of an educational facility is reduced to 80 percent of what it would be if the value ratio were 100.

Figure 8.11

BLUECITY SCHOOL DEPARTMENT JURISDICTION 1 ROUND 7

SCHOOL UNITS

SCHOOL	LOCATION	LEVEL	MAINTENANCE LEVEL	VALUE RATIO	STUDENTS HIGH	STUDENTS MIDDLE	STUDENTS LOW	TEACHERS REQUESTED HIGH	TEACHERS REQUESTED MIDDLE	STUDENT/TEACHER RATIO	USE INDEX
1	9030	1	5	89	0	12793	5700	3	3	22	103
2	10026	1	84	84	0	3	14600	2	2	26	137
3	9032	1	94	94	2600	7923	0	2	2	18	84
4	9034	1	84	84	0	11203	1100	2	2	22	116

UNDEVELOPED LAND

LOCATION	AMOUNT
11234	16

CONTRACTS

TYPE	OWNER	LOCATION	PERCENTAGE OF TOTAL PURCHASES	COST PER UNIT	CAPACITY UNITS USED	TOTAL COST
B6	C	98- 30	100	110000	44	4840000
B5	B	98- 32	100	97500	16	1560000
						6400000

ADULT EDUCATION

EMPLOYMENT REQUESTED HIGH	EMPLOYMENT REQUESTED MIDDLE	EMPLOYMENT OBTAINED HIGH	EMPLOYMENT OBTAINED MIDDLE	ACTUAL CAPACITY	USED CAPACITY	UNMET DEMAND
584	584	584	584	14600	14596	1985

SCHOOL AGE POPULATION IS	106580
NUMBER OF STUDENTS ATTENDING LOCAL SCHOOLS	55360
NUMBER OF STUDENTS ATTENDING PRIVATE SCHOOLS	51220
SALARY OFFERED HIGH INCOME TEACHERS	10100
SALARY OFFERED MIDDLE INCOME TEACHERS	5000

The sixth, seventh and eighth columns show the number of students from each of the three classes that attend public schools in each of the districts.

Columns nine and ten show the employment mix requests in terms of population units. The final column shows the School Use Index. It is the ratio of loading (demand) to effective capacity (supply) multiplied times 100.

If the School Department did not hire all the population units it requested, the following message is printed:

"7 MIDDLE INCOME TEACHER REQUESTS NOT FILLED"

This would indicate that 7 PM's were not hired.

b. Undeveloped Land

This table shows the parcel location for undeveloped land owned by the School Department. It also shows the percent of the parcel owned by the department. The percent of a parcel required for a level one school facility is shown in the School Master Table.

c. Contracts

The School Department purchases goods and services each round as part of the costs of operating and maintaining their school facilities. These purchases are made from BG and BS establishments in the local system if contracts to do so are submitted to the computer by the department. If no contracts to purchase locally supplied goods and services are made, then all needed purchases are made from the outside system.

The contract table shows the type of good or service in column one. In the second column, the owner of the establishment supplying the good or service is indicated. The third column shows the parcel location of the supplier if it is a supplier within the local system.

The fourth column shows the percent of total purchases made from BS and BS suppliers. The fifth column shows the cost per BG and BS unit being charged by the supplier. (The outside prices are fixed.)

The sixth column shows the number of BG and BS units purchased and the last column shows the total cost. This cost is derived by multiplying the cost per unit times the number of units purchased.

d. Adult Education

The School Department may operate a public adult education program if it wishes and can afford to pay the costs. The demand for public adult education is generated by the time allocations for free adult education by population units in the Social Sector.

It is assumed that adult education is carried out in the same school facilities used by the children in the public schools; therefore, the only cost to supplying adult education services is the hiring of part-time teachers. Teachers may be hired in any desired mix from the PH and PM classes.

The first two columns show the number of part-time work units requested by the School Department from the PH and PM classes, respectively. Since the School Department competes in the labor market with all other employers of part-time workers, there is a chance that occasionally not all the teachers sought will actually be hired. Therefore, columns three and four show the part-time work units actually obtained.

The capacity of the adult education program is obtained by multiplying the high income part-time units actually hired times 15 and added that to the number of middle income part-time units multiplied by 10. Thus PH teachers provide 50 percent more capacity per work unit hired than PM teachers.

The used capacity is the number of leisure time units allocated to public adult education that were able to be served by the actual capacity of the adult education program. The unmet demand (if any) is the excess of the desired amount of time spent in public adult education by the population units of the local jurisdiction over the amount that was actually able to be spent given the capacity of the jurisdiction's adult education program.

At the bottom of the Adult Education Table, the local school age population in the jurisdiction is shown along with the number of these students who attended the public schools and the number who attended private schools. The population units whose children attended private schools had to pay the specified tuition per student as shown in the School Master Table.

The salary offered PH and PM teachers is also listed at the end of the Adult Education Table. The same salary is offered to full time teachers for day classes and part-time teachers for adult education classes.

e. Boycotts

The Boycott Table shows three bits of information on the boycotting population units (team controlling, income class, and function which for School boycotts will always be work). Three bits of information are formatted for the boycotted employer. When the School Department is the employer being boycotted, "SC" and the jurisdiction number appear under the third column heading entitled "owner".

2. NEW CONSTRUCTION

The Construction Table shows projects that were completed at the beginning of the round and therefore were in operation for the entire round. "Outside" indicates that an outside construction firm performed the construction. The site location is the parcel on which the school facility was constructed. The status will always appear as "Completed".

Old level is the previous development level for the school facility. A zero indicates that no school facility previously existed on that parcel. The new level is the present development level for the school facility after the construction. The price of construction is indicated along with the department specified maintenance level (this applies to the entire structure) and the specified employment mix (this applies to the entire structure) and the specified employment mix (this applies to the new total level not only to the newly constructed increment).

3. SCHOOL DEPARTMENT FINANCES

Outstanding Bonds - This table shows the type (capital or current) of bond, the original principal, the number of rounds remaining to pay off the bond (all bonds start as 25 or 2 year bonds), the rate of interest being charged on the principal (determined by the state of the national bond market in the year the bond was floated), and the annual payment that must be made on the debt. Bond payments on a bond floated in round T being in round T+1. Thus a current bond incurred in Round 2 will start being paid off in Round 3.

Figure 8.12

BLUECITY — SCHOOL FINANCES — JURISDICTION 1

CAPITAL

REVENUES

PREVIOUS CASH BALANCE	792800
APPROPRIATIONS	13500000
FEDERAL-STATE AID USED	0
NEW BONDS	0
MISCELLANEOUS	0
TOTAL	14292800

EXPENDITURES

SCHOOL CONSTRUCTION	0
LAND PURCHASES	0
MISCELLANEOUS	0
TOTAL	0

CURRENT BALANCE	14292800

CURRENT

REVENUES

PREVIOUS CASH BALANCE	30711900
APPROPRIATIONS	19000000
FEDERAL-STATE AID USED	12456000
NEW BONDS	0
MISCELLANEOUS	16000000
	78167900

EXPENDITURES

GOODS AND SERVICES	6400000
FULL-TIME SALARIES	18108000
MISCELLANEOUS	0
BOND PAYMENTS	0
ADULT EDUCATION	14687600
	39195600

CURRENT BALANCE	38972300

THERE ARE NO OUTSTANDING BONDS

FEDERAL/STATE AID AVAILABLE FOR SCHOOL CONSTRUCTION

NONE

4. School Map

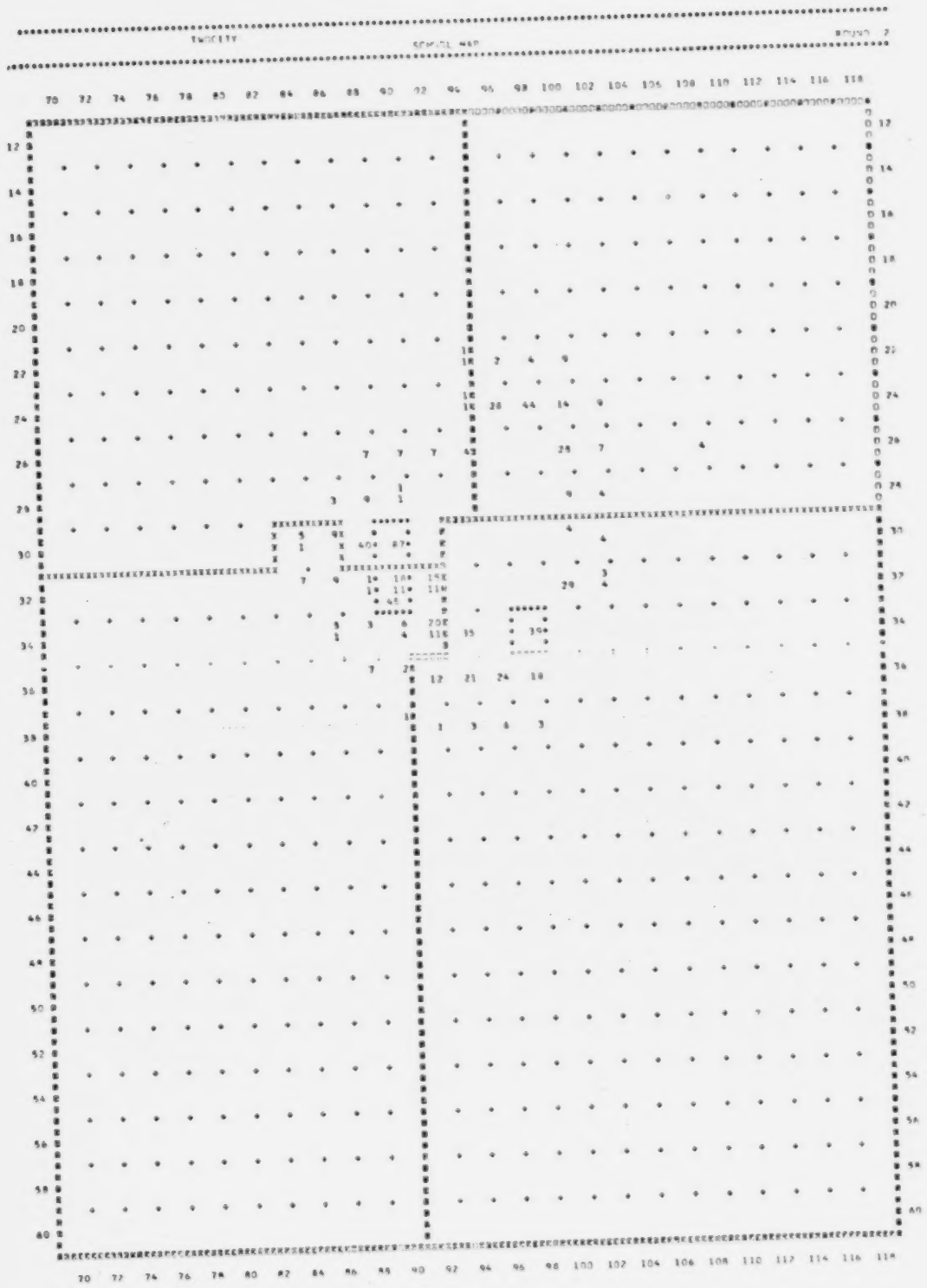
This map designates jurisdictional boundaries (000) and school district boundaries (xxx) for all school districts within each jurisdiction. A school district is a group of contiguous parcels that are within the service area of a school facility. Therefore, every school facility (conceptualized as a collection of elementary and secondary education buildings) has an associated school district. There may be parcels of land that are not served by a public school district. School aged children on these parcels are forced to attend private schools.

The information contained on a parcel of occupied residences shows the number of students attending the local public school (top line) and the number of students attending private schools (middle line). Both of these student figures are expressed in hundreds of students. The School Use Index is shown on those parcels on which a school facility is located. The parcels on which school facilities are located are surrounded by asterisks (***).

Students from high and middle income families will attend the local public schools only if a certain number of school quality criteria are met. Consult the School Master Table for the specific criteria.

The School Use Index is dependent upon the number of students attending the school district and the capacity of the school district given the level and value ratio of the school facility and the mix of teachers. As this index rises above 100 the quality of public school services declines. The School Use Index affects the neighborhood index (neighborhood dissatisfaction) which in turn affects migration and housing selection.

School district boundaries may be altered by the School Department in an effort to improve the supply-demand balance, serve areas previously not served, and/or change the social class mix of the students attending the public schools.


TWICELTY
SCHOOL MAP
PARCELS
TOP ROW: PUB SCHL STDNTS
MIDDLE ROW: PRV SCHL STDNTS
BOTTOM ROW: SCHL USE INDEX
EIF SCHL ON PARCEL
NUMBER OF STUDENTS IN LOOPS
PARCEL EDGES
BR DISTRICT BOUNDARY
BB JURISDICTION BOUNDARY
BR BOTH
** SCHOOL ON PARCEL

V. SCHOOL DEPARTMENT DECISIONS

A. Summary of Decisions

The three categories of decisions made by the School Department are those that are jurisdiction-wide in scope, those that pertain to individual school facilities and districts, and those that are capital land and construction decisions. The following table shows the nine types of decisions as they relate to these three categories.

Jurisdiction-wide
- Change Salary Levels
- Award BG and BS Contracts
- Transfer Cash
- Offer Adult Education

Individual School Facilities
- Change District Boundaries
- Change Maintenance Level
- Change Employment Requests

Capital
- Acquire and Sell Land
- Construct or Demolish School Facilities

The School Department does not need to make any decisions if it does not wish to do so. If no decisions are made, it is assumed that salaries, contracts, district boundaries, maintenance levels, and employment requests remain at their present values. If no decisions are made, there will be no cash transfers, land transfers, constructions, or demolitions.

The School Department must be aware of the local system constraints on its decision-making. Capital expenditures may not be made unless there are sufficient funds in the capital account. New appropriations from the Chairman may increase the amount of these capital funds.

B. Input Format

Local system decision-makers (such as the School Department) use a standardized input form (Figure SC-3.2) when making decisions that must be processed by the computer.

The standard message format is:

$CODE/ = dm/a, b, c, d, ...

1. $CODE stands for the type of decision code. The School Department has the option to make decisions that use the following decision codes:

$OTHER (adult education programs, salaries)
$CVPT (contracts, maintenance, employment)
$CASH (transfer cash)
$REDIST (redistrict)
$PU (land transfer)
$OUBLD (construct or demolish)
$FSA (request Federal-State aid)

2. "=dm" is the decision-maker, which for the School Department is SC1, SC2, or SC3, depending upon the appropriate jurisdiction number. A jurisdiction number must always follow the SC decision-maker code, even if there is only one active jurisdiction.

3. The columns "a", "b", and so forth are filled in with the appropriate information depending upon the particular decision.

Note that there is a slash (/) after the decision code and after the decision-maker code. There are commas separating all other bits of information. Note also that the decision-maker code is prefaced by an equals sign (=).

INPUT FORM

Note: When filling out this form, refer to input description form in the manual.

Please write clearly; distinguish between 1 (one) and "I" (eye), "Ø" (oh) and "0" (zero); be sure to fill in numbers exactly as required; omitting commas within numbers (100000).

RIVER BASIN MODEL

Decision Code	Decision-Maker	a	b	c	d	e	f	g	h	i	j	k
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____

SCHOOL DEPARTMENT: INPUT EXPLANATION FORM

Type of Decision	Code	Decision Maker	a	b	c	d	e	f
Purchase or bid on land	$PU	SC1, SC2, or SC3	location	price (in $1000's)	seller (economic decision-maker or department)	percent of parcel (0 if all)		
Change employment	$CVPT	SC1, SC2 or SC3	E	location	new number of PM units working there	new number of PH units working there		
Change maintenance level	$CVPT	SC1, SC2, or SC3	M	location	new maintenance level			
Change district boundaries	$REDIST	SC1, SC2 or SC3	location of school	list of new parcels in district in parentheses*				

*Parcels can be listed within parentheses by specifying upper left and lower right hand corners separated by ">". Example:

$REDIST/=SC1/ 9434, (9232 > 10040)

Type of Decision	Code	Decision-Maker	a	b	c	d	e	f	g
Transfer cash	$CASH	SC1, SC2, or SC3	C	receiver (economic or social decision-maker or department and jurisdiction	amount (in dollars)	from CAPital or CURrent account	if economic decision-maker receiving, PVT if social receiving, class receiving (H,M,or L); if department receiving, to CAPital to CURrent account	0	if social receiving, location receiving
Award BG or BS contracts	$CVPT	SC1, SC2, or SC3	C	location of BG or BS establishment	percent of total BG or BS purchase to be bought there	new priority	displaced priority	owner of BG or BS establishment	
Request adult education teachers	$OTHER	SC1, SC2, or SC3	EA	number of middle-income time units requested	number of high-income time units requested				

Figure SC-3.2

Type of Decision	Code	Decision-Maker	a	b	c	d	e	f
Change salaries	$OTHER	SC1, SC2, or SC3	S	salary to middle income worker (in $100's)	salary to high income worker (in $100's)			

			a	b	c	d	e	f	g
Construct, upgrade or demolish a school by the "Outside System"	$OUBLD	SC1, SC2, or SC3	site location	SC	old level (0, if new building)	new level	new maintenance level	number of PM's working	number of PM's working there

C. Sample Decisions for the School Department

(The input format is shown on the sample input. Note that the jurisdiction number must always be given even if only a single jurisdiction exists.)

Jurisdiction-Wide Decisions

1. Change Salary Levels
   The School Department in Jurisdiction 2 wishes to change its salaries for PM's to $5200. Note that no dollar signs need to be placed on the dollar amounts and that the old salary for the PH's must also be input. The decision is to change salaries, and if nothing had been placed in the column for PH salary, the computer would read the blanks as zeros and the new PM salary would be put to the minimum amount.

2. Award BG or BS Contracts
   Case 1: The School Department in Jurisdiction 3 wishes to made a BG contract so that all its purchases will be made from a single local supplier (BS at 9830). Presently, all the purchases are being made from the Outside system.
   Case 2: The School Department in Jurisdiction 1 wishes to split its BS purchases between two local suppliers in such a way that one gets 60 percent of the School Department business (BS at 10012) and the other gets 40 percent (BS at 10636). Previously, a third BS establishment at 11040 had supplied all of the BS services for the School Department. Its contract must be negated.

   A department in a jurisdiction may not have more than three contracts for BG or more than three contracts for BS purchases.

3. Transfer Cash
   Case 1: The School Department in Jurisdiction 2 wishes to transfer $1,000,000 from its current account to its capital account.
   Case 2: The same department wishes to transfer $525,000 to Economic Team B from its current account.

4. Adult Education
   The School Department in Jurisdiction 2 decides to hire 250 time units of PM teachers and 300 time units of PH teachers.

Operational Decisions for Specific School Facilities

5. Change District Boundaries
The decision to change the boundaries for one school facility does not require that the boundaries for other school facilities be changed unless contiguity is involved. If the School Department makes substantive error in any of its redistricting decisions in a round, all the redistricting decisions are rejected. The School Department in Jurisdiction 1 decides to add a previously unserved parcel (9048) to the School district served by the school on parcel 9036. It also wants to add parcels 9840, 9842, 10040 and 10042. These four parcels form a "block input".

6. Change Maintenance Level
The School Department in Jurisdiction 2 decides to raise the maintenance level for its school facility at 7420 to 80, and to lower the maintenance level for its school facility at 7630 to 85.

7. Change Employment Requests
The School Department in Jurisdiction 2 decides to change the labor mix for the school facility at 7420 to 3 PM and 4 PH and to change the mix at the second level school at 7630 to 7 PM and 8 PH.

Capital Decisions

8. Acquire or Sell Land
Case 1: The School Department in Jurisdiction 1 purchases 12 percent of parcel 7842 from Economic Team B for $570,000.
Case 2: The School Department in Jurisdiction 2 attempts to purchase 24 percent of parcel 10032 from Outside System owners with un unsolicited bid of $1,500,000.
Case 3: The School Department in Jurisdiction 3 gives 12 percent of parcel 8436 to the Planning and Zoning Department in its jurisdiction. (Note that the receiver is designated as the decision-maker.)

9. Construct a School Facility
Case 1: The School Department in Jurisdiction 1 wishes to build a school facility on parcel 8832, have a maintenance level of 90, and hire 3 PM's and 3 PH's to work there.

Case 2: The department also decides to upgrade the school facility on parcel 10020 from a level 1 to a level 3 and make the new maintenance level for the entire facility be 85 and hire 12 PM's and 15 PH's.
Case 3: Because of the demolition of several residential structures within its boundaries, the school facility at 8640 has been slated for a reduction in capacity by the School Department in Jurisdiction 2. It is decided that the school should be reduced from a level 2 to a level 1 and the maintenance reduced to 70 and employment cut to 3PM and 2 PH.

SAMPLE DECISION INPUTS FOR THE SCHOOL DEPARTMENT

	Decision Code	Decision-Maker	a	b	c	d	e
1.	$ ØTHER /	= SC1 /	S ,	52 ,	100 ,	____ ,	____ ,
2.1	$ CVPT /	= SC3 /	C ,	9830 ,	100 ,	____ ,	____ ,
2.2	$ CVPT /	= SC1 /	C ,	10012 ,	60 ,	____ ,	____ ,
2.2	$ CVPT /	= SC1 /	C ,	10636 ,	40 ,	____ ,	____ ,
2.2	$ CVPT /	= SC1 /	C ,	11040 ,	0 ,	____ ,	____ ,
3.1	$ CASH /	= SC2 /	C ,	SC2 ,	1000000 ,	CUR ,	CAP ,
3.2	$ CASH /	= SC2 /	C ,	B ,	525000 ,	CUR ,	PVT ,
4	$ ØTHER /	= SC2 /	EA ,	250 ,	300 ,	____ ,	____ ,
5	$ REDIST /	= SC1 /	9036 ,	(9048 ,	9840 >	10042)	____ ,

SAMPLE DECISION INPUTS FOR THE SCHOOL DEPARTMENT (CONT'd)

	Decision Code	Decision-Maker	a	b	c	d	e	f	g	h
6.	$CVPT / =	SC2 /	M	7420	80 /	M	7630	85		
7.	$CVPT / =	SC2 /	E	7420	3	4 /	E	7630	7	8
8.1	$PU / =	SC1 /	7842	570	B	12				
8.2	$PU / =	SC2 /	10032	1500	ØU	24				
8.3	$PU / =	PZ3 /	8436	0	SC3	12				
9.1	$ØUBLD / =	SC1 /	8832	SC	0	1	90	3	3	
9.2	$ØUBLD / =	SC1 /	10020	SC	1	3	85	12	15	
9.3	$ØUBLD / =	SC2 /	8640	SC	2	1	70	3	2	

VI. MASTER SHEET FOR THE SCHOOL DEPARTMENT

General Characteristics

	SC1
Construction Cost	$27,000,000
Land Requirements	6%
Annual Depreciation Rate	2%
BG and BS Requirements	
For 1% Maintenance	
BG	2 units
BS	.7 units
For Normal Operation	
BG	8 units
BS	3 units
Federal-State Aid	
Capital	$ for every local $1
Current (automatic)	$225 per student

Design Capacity (in Students) as a Function of the Number and Class of Population Units Assigned to Teach There

PM

PH	0	1	2	3	4	5	6
0		2,520	4,140	6,840	9,900	12,240	13,140
1	3,600	5,910	8,460	11,200	13,320	15,300	17,100
2	7,200	9,900	12,600	15,500	17,460	19,440	21,240
3	10,800	14,040	16,920	20,000*	21,960	23,760	25,560
4	13,140	17,460	21,060	23,400	25,200	27,000	28,620
5	17,100	20,700	23,400	26,640	28,440	30,000	31,500
6	19,800	23,850	26,820	29,880	31,320	32,850	34,200

*The least cost design capacity of an SC1

Master Sheet for the School Department -- Cont'd

Population Unit Characteristics

Characteristics	PH	PM	PL
Number of students	130	140	100
Criteria for Refusal Attend Public Schools			
Value Ratio (Min.)	80	60	None
Student-Teacher Ratio (Maximum)	18:1	22:1	None
Ratio of High to Middle Teachers (Minimum)	1:1	3:4	None
Cost of Private Education (for students)	$39,000	$24,500	$12,500

Capital Federal-State Aid

1st Request: 60% chance of acceptance

2nd Request: 40% chance of acceptance

3rd Request: 30% chance of acceptance

ADULT EDUCATION

School Demand

Ead time unit allocated to public adult education is a unit of demand.

School Supply

Classes held in public school facilities - only additional cost is for part-time teachers.

One Unit of Time by Pl Hired	Provides Units of Adult Education
PH	15
PM	10

APPENDIX A

Sequence of Computer Print-Out

Although sections of the computer output can be distributed in any order and in any combination to players, it is printed in a fixed order with which the director should become familiar. The overall order of output is:

1. Migration
2. Water System
3. Employment
4. Commercial Allocation
5. Social Sector
6. Economic Sector
7. Social and Economic Summaries
8. Government Detail
9. Summary Statistics
10. Maps

Within each of these major output sections there are several subsections. An additional section of print-out results from the processing of decisions on a data base. That print-out, called EDIT, has no fixed sequence within it; the order of decision input is the order in which EDIT processes and lists player and director decisions. The EDIT print-out is separate from the print-outs listed above. These print-outs reflect the simulated region's status in response to the previous year's data base and any changes made to it through EDIT.

Each subsection of output has its own title, but on every subsection the heading for the data base and the round number are printed. A list of the titles of print-out sections in the order in which they are printed and a description of each are given below and are summarized in Figure 4.

Print-Out Section	Description
1. Migration	
Environmental Indexes	For each class which can live on each residence parcel, this shows the value of each component of the environmental index based on last round's pollution index, MS use index and school use index and this round's residence quality, rent, tax rates, and welfare rates.

Figure 4

RIVER BASIN MODEL OUTPUT

1. Migration
   - 1.1 Environmental Indexes
   - 1.2 Personal Indexes
   - 1.3 Dissatisfaction Cutoffs
   - 1.4 Migration Detail
   - 1.5 Migration Statistics
   - 1.6 Migration Summary

2. Water System
   - 2.1 Water User Effluent Content
   - 2.2 River Quality During Surface Water Process
   - 2.3 Water User Costs and Consumption
   - 2.4 Coliform and Pollution Index Values

3. Employment
   - 3.1 Employment Selection Information for PL Class
   - 3.2 Employment Selection Information for PM Class
   - 3.3 Employment Selection Information for PH Class
   - 3.4 Part-Time Work Allocation for PH Class
   - 3.5 Part-Time Work Allocation for PM Class
   - 3.6 Part-Time Work Allocation for PL Class
   - 3.7 Employment Summary

4. Commercial Allocation
   - 4.1 Personal Goods Allocation Summary
   - 4.2 Personal Services Allocation Summary
   - 4.3 Business Goods Allocation Summary
   - 4.4 Business Services Allocation Summary
   - 4.5 Government Contracts
   - 4.6 Terminal Demand and Supply Table
   - 4.7 Terminal Allocation Map

5. Social Sector
   - 5.1 Dollar Value of Time
   - 5.2 Social Decision-Maker Output
   - 5.3 Social Boycotts

6. Economic Sector
   - 6.1 Farm Output
   - 6.2 Residence Output
   - 6.3 Basic Industry Output
   - 6.4 Commercial Output
   - 6.5 Economic Boycott Status
   - 6.6 New Construction Table
   - 6.7 Land Summary
   - 6.8 Loan Statement
   - 6.9 Financial Summary

7. Social and Economic Summaries
   - 7.1 Number of Levels of Economic Activity Controlled by Teams
   - 7.2 Employment Centers
   - 7.3 Economic Control Summary for Teams
   - 7.4 Social Control Summary for Teams
   - 7.5 Social Control Summary Totals
   - 7.6 Economic Graphs for Teams
   - 7.7 Social Graphs for Teams

8. Government Detail
   - 8.1 Assessment Report
   - 8.2 Water Department Reports
   - 8.3 Sampling Station Report: Point Source Quality
   - 8.4 Sampling Station Report: Ambient Quality
   - 8.5 Utility Department Report
   - 8.6 Utility Department Finances
   - 8.7 Municipal Services Department Report
   - 8.8 Municipal Services Department Finances
   - 8.9 Municipal Services Department Construction Table
   - 8.10 Planning and Zoning Department Report
   - 8.11 School Department Report
   - 8.12 School Department Finances
   - 8.13 School Department Construction Table
   - 8.14 Highway Department Finances
   - 8.15 Highway Department Construction Table
   - 8.16 Rail Company Report
   - 8.17 Bus Company Report
   - 8.18 Chairman Department Finances
   - 8.19 Tax Summary
   - 8.20 Financial Summary

9. Summary Statistics
   - 9.1 Demographic and Economic Statistics

10. Maps
   - 10.1 Personal Goods Allocation Map
   - 10.2 Personal Services Allocation Map
   - 10.3 Business Commercial Allocation Map
   - 10.4 Municipal Service Map
   - 10.5 School Map
   - 10.6 Utility Map
   - 10.7 Water Usage Map
   - 10.8 Water Quality Map
   - 10.9 Municipal Treatment
   - 10.10 Municipal Intake and Outflow Point Map
   - 10.11 Surface Water Map
   - 10.12 Farm Runoff Map
   - 10.13 River Basin Flood Plain Map
   - 10.14 Farm Map
   - 10.15 Farm Assessed and Market Value Map
   - 10.16 Market Value Map
   - 10.17 Assessed Value Map
   - 10.18 Economic Status Map
   - 10.19 Highway Map
   - 10.20 Planning and Zoning Map
   - 10.21 Parkland Usage Map
   - 10.22 Socio-Economic Distribution Map
   - 10.23 Demographic Map
   - 10.24 Social Decision-Maker Map
   - 10.25 Topographical Restriction Map
   - 10.26 Government Status Map

Reproduced from best available copy.

Print-Out Section	Description
Personal Indexes	For each class living on each residence parcel, this shows the value of each component of the personal index based on last round's time allocation, residential crowding, MS use index, and coliform bacteria index.
Migration Detail	For each residence parcel and for each class which lived on the parcel immediately before or after the migration program ran, this shows the number of Pl's in the class now residing on the parcel and of those who moved, why they moved and where they came from and went to.
Migration Statistics	Number of in-migrants, out-migrants, internal migrants, and natural population growth by jurisdiction and class.
Migration Summary	The number of Pl's who moved between or within jurisdictions by class, by jurisdiction and by reason for moving.

2. Water System

Water User Effluent Content	For each economic activity and municipal water system, the volume of effluent dumped into the surface water and the amount of each pollutant in the effluent after the effluent has received any treatment.
River Quality During Surface Water Process	For each of the five stages in the surface water process and for the surface water on each parcel through which a river flows, this shows the water quality rating, the volume of water, and the amount of each pollutant present.

Print-Out Section	Description
Water User Costs and Consumption	This shows for each economic activity the amount of water which it required, the amount which it obtained from its normal source and the cost which it paid to purchase water, to treat its intake water, to recycle water and to treat its effluent.
Coliform and Pollution Index Values	Map showing, for each parcel containing surface water, the coliform count and the water quality rating. The pollution indexes for such parcels and for parcels bordering parcels containing surface water are also shown.

3. Employment

Employment Selection Information for Low-Income Class	Tabular output showing the place of residence of all Pl's, their employers, the number of Pl's not employed and employed by each employer, the salary of each employer, the time units consumed in transportation to work, the cost of using an auto to go to work, the costs using a bus and/or rail to go to work, and the route used to travel to work whether by auto or public transit.
Employment Selection Information for Middle Income Class	Tabular output showing the place of residence of all Pl's, their employers, the number of Pl's not employed and employed by each employer, the salary of each employer, the time units consumed in transportation to work, the cost of using an auto to go to work, the costs using a bus and/or rail to go to work, and the routes used to travel to work whether by auto or public transit.

Print-Out Section	Description
Employment Selection Information For High Income Class	Tabular output showing the place of residence of all Pl's, their employers, the number of Pl's not employed and employed by each employer, the salary of each employer, the time units consumed in transportation to work, the cost of using an auto to go to work, the costs using a bus and/or rail to go to work, and the routes used to travel to work whether by auto or public transit.
Part-Time Work Allocation For High Income Class	Tabular list of residence location of part-time workers, their employers, the number of part-time units spent working, and the yearly salary rate.
Part-Time Work Allocation for Middle Income Class	Tabular list of residence location of part-time workers, their employers, the number of part-time time units spent working and the yearly salary rate.
Part-Time Work Allocation for Low Income Class	Tabular list of residence location of part-time workers, their employers, the number of part-time time units spent working and the yearly salary rate.
Employment Summary	Information by class and total for the number of Pl's employed at their design level or at lower levels, the number unemployed, the total number of Pl's, the part-time units worked, and the number of jobs full time that were not filled by the local labor force.

4. Commercial Allocation

Personal Goods Allocation Summary	Tabular output showing the identification number assigned to each PG establishment, its

Print-Out Section	Description
	location, owner, level, effective capacity, actual capacity used, price, and gross sales. For each customer it shows the store to which it is assigned, the customer location and type or class, the customer's owner, the consumption units (including those for maintenance and recreation), transportation costs (shadow costs in the case of residences) the purchase cost (total cost in the case of residences), and total cost.
Personal Services Allocation Summary	This is identical in format to the Personal Goods Allocation Summary but gives details regarding personal services.
Business Goods Allocation Summary	For businesses which require business goods, the format is the same as for personal goods. In addition, there is a section called Government Contracts which shows, for each school and MS department, how many consumption units it purchases from each business goods establishment.
Business Services Allocation Summary	This is identical in format to the Business Goods Allocation Summary but gives details regarding business services.
Terminal Allocation Summary	Tabular list of the location, business type (land use), and terminal requirements of each terminal user. Each terminal is assigned an identification number and its location, level, and usage are noted.

Print-Out Section	Description
Terminal Allocation Map	Map showing the code number of the terminal to which each terminal user in the local system is assigned.
5. Social Sector*	
Dollar Value of Time	This table shows, by team and by class, the dollar value of a time unit spent in travel.
Social Decision-Maker Output	By jurisdiction, by social decision-maker, and by class, a table in which each social characteristic is a row and each residence parcel is a column. The characteristics are descriptive and financial.
Social Boycotts	Detail on who is boycotting, what function they are boycotting, and similar details about social boycotts appear on this output.
6. Economic Sector**	
Farm Output	Tabular list, one row per farm, showing the farm code number, farm type, number of parcels comprising the farm, number of percents of parcels comprising the farm, the farm's fertilizer level, normal income, actual income, land taxes, and total net income.

*The dollar value of time prints a table for each jurisdiction, although at this time the value is set for a team and class without regard to jurisdiction. The rest of the social detail prints in order of jurisdiction number, within that in alphabetical order, and within that in order of class (low first, high last). Output for any classes which a team does not control in a jurisdiction is not printed. Likewise, a class having no boycotts receives no boycott output.

**The economic output prints by team in alphabetical order. All of a single team's output is printed before the next team's output begins. A team for which a section of output is irrelevant does not receive that section of output. For example, a team with no residences receives no residence output. Likewise, a team which has no loans outstanding as either a debtor or a creditor does not receive a loan summary. All active teams receive financial summaries.

Print-Out Section	Description
Residence Output	Tabular list of descriptive and financial information about each residence parcel which the decision-maker controls.
Business Output	Tabular list of descriptive and financial information about each business which the decision-maker controls. All basic industries are grouped together and precede the group of personal commercial and business commercial.
Construction Industry Output	Tabular list of descriptive and financial information about each construction industry which the decision-maker controls.
Construction Industries' Contract Table	Description of all contracts made by construction industries controlled by the decision-maker.
Economic Boycott Status	Detail on all boycotts in which the decision-maker is either the party boycotting or the party being boycotted.
New Construction Table	Detail on all construction contracts in which the decision-maker is the contractee.
Land Summary	Tabular list of the location of parcels owned by a team, their assessed value, percent that is undeveloped and private, the taxes on undeveloped land, the percent publicly developed and undeveloped, the percent undevelopable because of topographical constraints, the utility capacity available and used.

Print-Out Section	Description
Loan Statement	Tabular list showing borrower, lender, interest rate, years remaining on the loan, the original principal, and the annual payment.
Financial Summary	A cash flow statement showing expenditures and income, a portfolio of conservative and speculative stocks, a balance sheet of assets and liabilities, and the amount which the decision-maker can borrow.

7. Social and Economic Summaries

Number of Levels of Economic Activity Controlled by Teams	A table listing the number of levels of each economic activity controlled by each team.
Employment Centers	Table showing the locations, number of job openings, number of Pl's hired, and salaries offered by Federal-State Employers; table showing, for each local government employer, the location of its employment center.
Economic Control Summary*	For each non-farm economic activity, this table shows its location, type and operating level of activity, production index (0-100) or occupancy rate (0-120), net income, and rate of return.

*This table prints for each economic team in alphabetical order.

Print-Out Section	Description
Social Control Summary*	For each class living on each parcel controlled by a single two-letter social decision-maker, this table shows the residence location, class, gross income per worker, family savings and total dissatisfaction (quality of life index).
Social Control Summary	By jurisdiction and by class, the number of Pl's controlled by each social decision-maker.
Economic Control Summary	This prints two graphs for each economic decision-maker, in alphabetical order. The first is, for up to ten rounds, the average net income from the team's economic activities each round, expressed as a ratio of the first round's net income. The second is a ten-round history of the average rate-of-return of the team's economic activities, expressed as a percent.
Social Control Summary	This prints two graphs for each social decision-maker, in alphabetical order. The first is a ten-round history of the average net income earned by each class which the team has controlled. The second is a ten-round history of the average quality-of-life index of each class which the team has controlled.

*This table prints for each social decision-maker in alphabetical order.

Print-Out Section	Description
8. Government Detail*	
Assessment Report	List of assessment ratios, special assessments and other policies set by the Assessor.
Water Department Reports	List of intake and outflow treatment plant locations. levels, types, capacities, operating costs, volume treated, income, intake and outflow point locations, prices charged to municipal water users, pollutant concentration in municipal effluent (for those districts which are sampled).
Sampling Station Report: Point Source Quality	For those economic activities whose effluent is sampled by the local government, this shows the volume of effluent and the concentration of each pollutant after any treatment.
Sampling Station Report: Ambient Quality	For any parcel on which the jurisdiction measures the quality of the surface water leaving the parcel, this output shows the concentration of each pollutant.
Utility Department Report	Tabular list of utility plants, their location, level, units installed from each plant, units served, total operating costs per unit, and income derived from charges. Also listed is the charge per utility unit to customers, undeveloped land and outstanding bonds.

*A department's output is printed for all jurisdictions before the next department's output is printed.

Print-Out Section	Description
Utility Department Finances	Summary of all current and capital revenues, expenditures, and new balances.
Municipal Services Department Report	Tabular list of MS locations, maintenance levels, value ratios, effective capacities, loading (units of capacity used), number PL and PM's working, and the MS use indexes. Also shown are the salary levels, contracts to purchase BG and BS, the locations of undeveloped land, and outstanding bonds.
Municipal Services Department Finances	Summary of all current and capital revenues, expenditures, and new balances.
Municipal Services Department Construction Table	For each MS construction or demolition, this shows the location of the construction firm, the MS location, the status of construction, the old and new level of the MS, the contracted price, the maintenance level, and the number of PL's and PM's assigned to work at the MS.
Planning and Zoning Department Report	Total jurisdiction population, total amount of parkland, outstanding bonds, and capital revenues, expenditures, and new balance.
School Department Report	Tabular data on school unit locations, levels, maintenance levels, value ratios, students attending, teachers, student-teacher ratios, and use indexes. Also data on undeveloped land, BG and BS contracts and cost of purchases, adult education summary, and several summary school statistics.
School Department Finances	Summary of all current and capital revenues, expenditures, and new balances.

Print-Out Section	Description
School Department Construction Table	For each school construction or demolition, this shows the location of the construction firm, the school building location, the status of construction, the old and new level of the school, the contracted price, the amount of federal-state aid used, the maintenance level for the school, and the number of PM's and PH's assigned to work at the School.
Highway Department Report	A financial report showing capital and current expenditures and revenues, outstanding bonds, a summary of maintenance levels and expenditures by road type, a summary of road conditions, a terminal status report, a list of undeveloped land, and a status report on available federal-state aid.
Highway Department Construction Table	For each road or terminal construction or demolition, this shows the construction firm, the location of the road or terminal, the status, the old and new level, the contracted price, and the dollar amount of federal-state aid used.
Rail Company Report	A financial report showing capital and current revenues and expenditures, outstanding bonds, employment costs, the amount and condition of rolling stock, the fare structure, passengers and total fares by route, and the number of passengers using each segment of each route.

Print-Out Section	Description
Bus Company Report	A financial report showing capital and current revenues and expenditures, outstanding bonds, employment costs, the amount and condition of rolling stock, the fare structure, passengers and total fares by route, and the number of passengers using each segment of each route.
Chairman Department Finances	This shows the welfare payment per unemployed worker and the financial summaries for municipal services, schools, highways, planning and zoning, utilities, and the chairman's account. Also included are the Chairman's outstanding bonds.
Tax Summary	Tabular list showing by the eight types of local tax bases, the dollar amount of the tax base, the tax rate, and the revenue generated.
Financial Summary	Tabular list, for each department, of current and capital appropriations, federal-state aid, total revenue, total expenditures and final surplus or deficit.

9. Summary Statistics

Demographic and Economic Statistics	Tabular list by jurisdiction of population and its characteristics, land usage, housing, employment, earnings, income from the national economy, outflows to the national system, and national business cycle effects.

Print-Out Section	Description
10. Maps	
Personal Goods Allocation Map	Map showing the locations and code numbers of all personal goods establishments, locations of all PG users, and the code number of the PG to which each PG user is assigned.
Personal Services Allocation Map	Map showing the locations and code numbers of all personal services establishments, locations of all PS users, and the code number of the PS to which each PS user is assigned.
Business Commercial Allocation Map	Map showing the locations and code numbers of all business goods and business services establishments, locations of all BG and BS users, and the code numbers of the BG and BS to which each BG and BS user is assigned.
Municipal Service Map	Map showing the locations of MS's and their districts, the locations of economic activities, the number of MS units drained by each economic activity and MS use indexes.
School Map	Map showing the locations of schools and their districts, school use indexes, and the number of children on each residence parcel attending public and private schools.
Utility Map	Map showing the locations of utility plants and their districts, the number of utility units installed on each parcel, and the number of utility units drained on each parcel.

Print-Out Section	Description
Water Usage Map	Map showing the locations of economic activities, the percent recycling at basic industries, and the type and level of basic industries' effluent treatment plants.
Water Quality Map	Map showing the locations of economic activities, the surface water quality on those parcels having surface water, and the pollutant which caused the water quality rating.
Municipal Treatment Plant Map	Map showing locations, types and levels of municipal intake and outflow treatment plants.
Municipal Intake and Outflow Point Map	Map showing locations of municipal intake and outflow points and the utility districts which they serve.
Surface Water Map	Map showing, for each parcel having surface water, the volume of water on the parcel, its rate of flow, and the percent of the surface area of the parcel consumed by water.
Farm Funoff Map	Map showing for each farm its type and where its runoff flows into the surface water.
River Basin Flood Plain Map	Map showing the locations of river basins, the dam priority of each river basin, and the flood susceptibility of each parcel in the river basin.
Farm Map	Map showing the location of each farm, its owner, its code number, the percent of each farm parcel which is in farm use, the type of farm, and its fertilizer level.

Print-Out Section	Description
Farm Assessed and Market Value Map	Map showing, for each farm parcel, its assessed and market value and the percent of the parcel which is in farmland.
Market Value Map	Map showing, for each privately-owned non-farm parcel, the market value of 100% of the land, the market value of the privately-owned buildings, and the total market value of the privately-owned land and buildings.
Assessed Value Map	Map showing, for each privately-owned non-farm parcel, the assessed value of the privately-owned land, the assessed value of the privately-owned buildings, and the total assessed value of the privately-owned land and buildings.
Economic Status Map	Map showing the economic sector owner of each privately-owned non-farm parcel, its zoning, the type and level of economic activity, the level of utilities installed, and, for every parcel, the percent of the parcel which is privately-owned and undeveloped.
Highway Map	Map showing the locations and types of roads and terminals and the locations, types, and levels of non-farm economic activities.
Planning and Zoning Map	Map showing the zoning classification of those parcels which are zoned, the percent of each parcel which is parkland, and the percent of each parcel which is public institutional land.

Print-Out Section	Description
Parkland Usage Map	Map showing the percent of each parcel which is in parkland or public institutional use, the population served by the park, and the park's use index.
Socio-Economic Distribution Map	Map showing, for each residential parcel, the type and level of housing and the number of Pl's in each class living there.
Demographic Map	Map showing the population (in 100's), percent occupancy, and quality index (QI) for all residential parcels, and the value ratio (VR) for all private non-residential developments.
Social Decision-Maker Map	Map showing, for each class living on a residential parcel, the social decision-maker which controls the class on that parcel.
Topographical Restriction Map	Map showing the percent of each parcel which is undevelopable due to topographical or other restrictions (e.g., mountains or military bases).
Government Status Map	Map showing the locations and levels of schools, municipal services, utility plants, roads, and terminals.

COMMERCIAL OUTPUT

The Commercial Allocation Process

All people and businesses and two government departments purchase goods and services each round in order to function. People and residence owners (for residential maintenance) purchase from Personal Goods (PG) and Personal Services (PS) establishments; businesses, schools, and municipal services purchase from Business Goods (BG) and Business Services (BS) establishments. The procedures for allocation of PG and PS buyers to sellers are identical. The procedures for allocation of BG and BS buyers to sellers are similar to the PG and PS allocation and identical to each other. The computer program performs the entire allocation process, but is affected by player decisions.

Each user of goods and services requires a certain number of consumption units. A consumption unit is an expression which represents a quantity to be purchased, regardless of what items in reality comprise that quantity. The quantity of goods or services which a seller can provide is also expressed as a certain number of consumption units. Each seller of goods or services sets a price which must be paid for each consumption unit purchased at his commercial establishment. Usually PG and PS prices are similar and BG and BS prices are similar. The quantity which each buyer of goods and services must obtain is indirectly derived from player decisions by the computer program. The program relates the local supply to that demand in the commercial allocation process, which simulates the decision of each buyer as to where it will purchase its required goods and services.

The PG-PS allocation process is run before the BG-BS allocation process. A description of PG allocation suffices as a PS description.

The buyers of PG are each class living on each residence parcel and each residence unit incurring maintenance. P1's buy for themselves to live; residence owners buy goods for maintenance only. All of the same class living on the same residence parcel purchase at the same PG; a residence owner buys all of a single residence parcel's maintenance at the same PG.

Each buyer of PG attempts to purchase from the PG establishment at which it can obtain its goods most cheaply. The buyer's cost per consumption unit (CU) is the cost per CU at the establishment plus the least transportation cost

per CU to get from the buyer's location to the establishment. There are two additional factors in a buyer's perception of a seller's price. One is the buyer's bias toward shopping where it shopped in the previous round. The other is the buyer's bias against shopping at an establishment which was overused in the previous round, i.e., an establishment at which more CU's were sold than the establishment could adequately provide. There is no absolute limit on the amount which a PG can sell, but as it sells more than its effective capacity to provide, its service deteriorates.

Each buyer selects the PG establishment at which it incurs the least perceived total cost. A buyer does not even consider selecting a PG which it is boycotting. All buyers choose simultaneously, and then reevaluate their selections in light of the new usage. The evaluation process is repeated until no commercial establishment changes its usage on two successive reevaluations. The cost which a buyer pays is the actual price at the PG which it selects and the actual least transportation cost to get to that PG.

There is one competitor for local PG establishments: the Outside. The Outside is treated the same as any other PG in the allocation process, but its price is higher than the typical local price (see Master Tables for Outside prices and typical local prices). There is, however, no transportation cost to shop Outside, and no crowding effect. A PG buyer purchases Outside if the Outside price is less than its least perceived local cost to shop. The Outside has unlimited capacity.

Output

There are four main parts to the commercial output:

PERSONAL GOODS ALLOCATION SUMMARY
PERSONAL SERVICES ALLOCATION SUMMARY
BUSINESS GOODS ALLOCATION SUMMARY
BUSINESS SERVICES ALLOCATION SUMMARY

Again, an explanation of PG applies, to a great extent, to the other allocations.

The first section concerns PG establishments. Each PG has a code number. The Outside is always code number one. In the row beside the code number are the location of the PG, its owner, development level, effective capacity (in CU's), the number of CU's sold, the price charged per CU, and the PG's gross income (price per CU times CU's sold). The Outside has no owner, level, or capacity.

Figure 4.1

TWOCITY
PERSONAL GOODS ALLOCATION SUMMARY

ROUND 2

PERSONAL GOODS

NUMBER	LOCATION	OWNER	LEVEL	CAPACITY	CAPACITY USED	PRICE/CU	GROSS INCOME
1	OUTSIDE				4144	13000	53872000.
2	9230	E	1	13148	13822	10000	138220000.
				TOTAL	17966		192092000.

CUSTOMERS

PERSONAL GOODS ASSIGNED TO	LOCATION	CLASS OR LAND USE	DECISION MAKER CONTROLLING	CONSUMPTION UNITS	TRANSPORTATION COST	PURCHASE COST	TOTAL COST
2	9422	RA	B	1	1175.	10000.	11175.
2	9422	LOW	F	21	24675.	210000.	234675.
2	9422	MID	C	28	32900.	280000.	312900.
2	9622	LOW	D	42	49350.	420000.	469350.
1	9822	LOW	D	84	0.	1092000.	1092000.
1	10022	LOW	D	190	0.	2470000.	2470000.
2	9424	RA	C	2	1850.	20000.	21850.
2	9424	LOW	F	21	19425.	210000.	229425.
2	9424	MID	C	28	25900.	280000.	305900.
2	9624	RB	F	52	48100.	520000.	568100.
2	9624	LOW	D	590	545750.	5900000.	6445750.

The second section provides detail on all purchases of PG. The table contains one row for each purchaser of PG. The list is ordered by residence parcel location, from left to right and top to bottom across the board. For a single parcel, the list is in order of residence, low-income, middle-income, high-income. The first column contains the code number of the PG at which the buyer is shopping. The second column contains the coordinates of the residence parcel and the third identifies the type of buyer on the residence parcel (RA, RB, RC, LOW, MID, or HIGH). Next is a single letter identifying the decision-maker controlling the residence or class. For a residence, the letter denotes an economic decision-maker; for a class, the letter denotes a social decision-maker.

The number of consumption units which the buyer has obtained is the fifth item of information. The number of CU's required is calculated by the program but is affected by player decisions. The calculations are different for residential maintenance than for Pl's. A residence depreciates each round in response to several factors: normal depreciation (fixed), quality of local municipal services, sufficiency of local water for fire protection, and floods. Only the normal depreciation is not responsive to local conditions. As a residence depreciates, it becomes less attractive to people seeking housing. A residence owner can offset depreciation by setting a maintenance level for the residence. When the residence depreciates below that maintenance level, the program automatically calculates the number of PG and PS units required to restore the residence to the maintenance level. The values of the factors which affect depreciation and the number of PG and PS units required for each 1% maintenance are shown on the Master Tables. For example, suppose that an RB had a quality index of 70 and a maintenance level of 70, and that the Master Table showed that RB requires 4 PG units and 2 PS units per 1% maintenance. Suppose that the residence depreciated a total of 3% (3% of 100, not of 70). The RB would automatically purchase 3 x 4, or 12 units of PG, and 3 x 2, or 6 units of PS.

The total consumption of a class living on a single residence parcel is a function of three things: the class, the amount of time allocated to recreation, and the number of Pl's in the class living there. The fixed number of PG and PS units required by a Pl in each class are shown on the Master Table. The amount of time allocated to recreation is set by the decision-maker controlling the class on the parcel. The Master Table shows the number of PG and PS units which a Pl must purchase for each time unit spent in recreation. Suppose that there are 6 PM's on a parcel and that they have allocated 10 time units to recreation.

Suppose further that the Master Table shows that a PM requires 28 PG and 11 PS units per round, and .05 PG and .05 PS units per time unit in recreation. The 6 PM's would require:

28 x (10 x .05) x 6 = 84 PG units, and 11 x (10 x .05) x 6 = 33 PS units.

The transportation cost, the sixth column, is the total transportation cost which the buyer pays to obtain PG. The transportation cost is always zero if the buyer purchases from the Outside. The transportation costs printed for residences are dummy costs used for the purposes of assigning residential maintenance purchases to PG establishments; no one ever pays that cost.

The last two columns show the total purchase cost paid by the buyer to the PG establishment and the total cost paid by the buyer for the personal goods and transportation (columns six plus seven).

The Personal Services Allocation Summary contains the identical types of information regarding detail on buyers and sellers of personal services.

The Business Goods and Business Services summaries are also identical regarding economic sector buyers and sellers, with a few minor exceptions in the economic sector. For one, PG and PS buy from BG and BS in response to their sales resulting from the personal commercial allocation. The Master Table shows how many units of BG and BS a PG or PS must purchase for each CU which it sells.

A basic industry requires a fixed number of BG and BS units each round. The fixed number is the number which the Master Table shows as being required for a level one of the industry type. That amount times the industry's level is the industry's fixed consumption.

Businesses depreciate annually due to several factors. Like residences, businesses may offset depreciation through maintenance. The Master Table shows the number of BG and BS units required per 1% maintenance for each business type.

Business Goods and Business Services are the only business types which never pay for operating costs and maintenance costs locally. They purchase from the Outside.

The major difference between the BG-BS and PG-PS allocation processes is that BG and BS can have contracts to provide local schools and municipal services departments with their required goods and services. A department can

Figure 4.5

GOVERNMENT CONTRACTS

BUSINESS SERVICES	DEPARTMENT	CONSUMPTION UNITS	COST
1	MS1	3	390000
1	MS2	8	1040000

contract with several local goods and services establishments for up to a total of 100% of its requirement. If less than 100% of a department's requirement is contracted locally, then the rest is automatically purchased from Outside at the Outside price. Government contracts with BG and BS establishments are made by players; they enter into the commercial allocation process only in that they consume BG and BS capacity before the other BG-BS buyers select shopping locations and thus decrease a BG's or BS's remaining capacity. Sellers to government are assured of government purchases. The number of units which a department consumes is the sum of the operating needs of its facilities (number of levels times a fixed requirement per level) and its maintenance requirements. Both BG and BS allocation summary outputs have a table showing where government departments are buying BG and BS, how many units are consumed by each department, and the total income to the BG or BS establishment for those sales.

*U.S. GOVERNMENT PRINTING OFFICE 1972 484-484/193 1-3